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VOL. 35. Ser. A. Part 4. pp. 97–136. APRIL, 1947.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 3s. net.

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GARDINER (J. G.). **Report of the Minister of Agriculture for the Dominion of Canada for the Year ended March 31, 1945.**—212 pp. Ottawa, Ont., 1945.

In the section of this report dealing with botany and plant pathology (pp. 25–45), it is recorded that the bunch top (purple top) disease of potato in New Brunswick is caused by a virus that is readily transmitted by grafting to tomato and certain other solanaceous plants. It was not transmitted in a number of tests by *Macrosteles divisus*, Uhl., the vector of the aster-yellows virus, indicating that it is not the typical strain [*Chlorogenus callistephi* var. *vulgaris* of Holmes], but an aberrant one or possibly a different virus [*cf. R.A.E.*, A **31** 275].

The chemistry section (pp. 45–52) includes some information on insecticide sprays. It was found that on pear trees, oil with a viscosity of 200 S.S.U. gave a heavier deposit than oil of a viscosity of 100, and was sometimes less injurious in dormant sprays, whereas on apple trees, western oils with viscosities of 200 and 100 and eastern oil with a viscosity of 100 gave equally good deposits. Investigations of the reason for excessive amounts of arsenic in dehydrated apples showed that the use of clean washing tanks and frequent changes of washing solutions will reduce the arsenic to a point within the tolerance. In tests of fixed-nicotine sprays, heavier nicotine deposits on apples were obtained with Mississippi bentonite and nicotine sulphate mixed in the spray tank than with Alberta bentonite and nicotine sulphate mixed dry.

In the entomology section (pp. 53–68) it is reported that the wheat-stem sawfly [*Cephus cinctus*, Nort.] was present in enormous numbers over an extensive area in Alberta and Saskatchewan [*cf. R.A.E.*, A **34** 174]. In spite of heavy rains and excellent growing weather throughout most of this area, losses of wheat averaged more than 50 per cent. in some districts and reached 80 per cent. in many fields, but a large-scale experiment carried out in 1940–44 showed that the sawfly could be successfully controlled by community efforts in cultural, trapping and sowing practices. In west-central Saskatchewan, the flax bollworm [*Heliothis ononis*, Schiff.] destroyed 10 per cent. of the capsules of flax in many fields [*cf.* **33** 143; **35** 13]. Investigations on Say's grain bug [*Chlorochroa sayi*, Stål] indicated that this Pentatomid had increased rapidly since 1942 and was again a potential menace to the wheat crop of southern Alberta.

In eastern Canada, the cabbage Aphid [*Brevicoryne brassicae*, L.] seriously affected the yields of cabbage, cauliflower and turnip, which were already suffering from the effects of severe drought. White grubs [*Lachnosterna* spp.] killed extensive plantings of young nursery stock, particularly apple, pear and cherry seedlings, in the Niagara Peninsula in Ontario; soil treatment with DDT appeared to be ineffective against them. The wild *Solanum polyadenium* showed almost complete immunity to attack by the Aphids that infest potato in New Brunswick [*cf.* **31** 129]. An emulsion containing DDT, applied to the soil at the time of oviposition, gave disappointing results against the onion maggot [*Hylemyia antiqua*, Mg.] in Ontario. A dust of calomel [mercurous chloride] applied to the stems of transplanted cabbages protected them from attack by the cabbage maggot [*H. brassicae*, Bch.], but it was ineffective when applied to the soil, probably owing to extremely dry weather at the time of treatment. A spray of nicotine sulphate was the most promising substitute for derris against *Pyrausta nubilalis*, Hb., on maize. Poison baits for the control of cutworms in tobacco fields were as effective without molasses as with it [*cf.* **31** 458]. Derris dust and a dust containing 3 per cent. DDT killed a high proportion of the potato tuber flea beetle [*Epitrix tuberis*, Gentner] in British Columbia [*cf.* **35** 59]. The Colorado potato beetle [*Leptinotarsa decemlineata*, Say], the potato leafhopper [*Empoasca fabae*, Harr.], the imported cabbage worm [*Pieris rapae*, L.], the cabbage looper [*Plusia brassicae*, Ril.], the diamond-back moth [*Plutella maculipennis*, Curt.] and the zebra caterpillar

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[*Ceramica picta*, Harr.] proved to be very susceptible to DDT, and the tomato hornworm [*Protoparce quinquemaculata*, Haw.] and the striped and spotted cucumber beetles [*Diabrotica melanocephala*, F., and *D. duodecimpunctata*, F.] were easily killed by it. It was also effective, at least on certain crops, against the tarnished plant bug [*Lygus oblineatus*, Say] and related species. The common asparagus beetle [*Crioceris asparagi*, L.] was 16–32 times as susceptible to DDT as the spotted asparagus beetle [*C. duodecimpunctata*, L.]. DDT was very toxic to the onion thrips [*Thrips tabaci*, Lind.] in the greenhouse, but failed to control it in the field.

Experiments on methods of controlling *Calocoris norvegicus*, Gmel., a Mirid that attacks strawberry in Nova Scotia, showed that burning off the straw mulch in early spring was the most effective ; sprays of nicotine and soap gave promising results in laboratory tests, but were unsatisfactory in the field. Both the Mirid and the strawberry rootworm [*Paria canella*, F.] were readily killed by DDT. DDT was more effective than lead arsenate against newly hatched larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., in laboratory tests in Ontario and gave excellent protection on apple in the field so long as the fruit remained covered, but was not very persistent. The addition of summer oil as an adhesive resulted in severe scorching of the foliage. Serious infestations by the European red mite [*Paratetranychus pilosus*, C. & F.] developed on trees sprayed with DDT, apparently because its predators were destroyed. Similar results were obtained in British Columbia. In that province, an emulsion of a light petroleum solution of dinitro-o-cresol or dinitro-o-cyclohexylphenol applied to the trunks and scaffold boughs of apple trees in early spring killed up to 80 per cent. of the hibernating larvae in their cocoons on the sprayed parts of the trees and resulted in 50 per cent. reduction in infested fruits at harvest ; this treatment is therefore recommended as a supplement to summer sprays. Another recommendation, based on two years' experiments, is the use of a tank-mixture of nicotine sulphate and Mississippi bentonite with summer oil against the second generation. A by-product of the paper industry known as tall oil has proved a good and cheap substitute for oleic acid in the emulsification of summer oil. In British Columbia only a soap such as that prepared with monoethanolamine and tall oil or oleic acid is recommended as the emulsifier for summer oil in order to ensure a uniform deposit of a solid insecticide such as nicotine fixed on bentonite. For three years, non-refined oils of only 4–5 per cent. unsulphonated residue have given satisfactory experimental results in summer applications with fixed nicotine. It is pointed out that females of *C. pomonella* oviposit chiefly between 7 and 11 p.m., so that weather during this period of the day is of critical importance ; a rise of 10°F. at dusk may result in four times as many eggs being laid. It was found that temperature and humidity may vary greatly in orchards close to one another. Inspections carried out in nine apple-packing houses in southern Okanagan in the autumn of 1944 showed that the San José scale [*Quadraspidiotus perniciosus*, Comst.] was fairly well distributed, though quite concentrated in certain areas, and that the European fruit scale [*Q. ostreaeformis*, Curt.] was very prevalent in orchards in which dormant sprays were not applied at least every two years. DDT was very effective against the white apple leafhopper [*Typhlocyba pomaria*, McAtee] and the grape leafhopper [*Erythroneura*] and the most effective material tested against the cranberry fruit-worm [*Mineola vaccinii*, Ril.], and gave satisfactory control of the rose chafer [*Macrodactylus subspinosus*, F.]. It gave promising results against the oriental fruit moth [*Cydia molesta*, Busck], but was also highly toxic to the parasites that normally control the moth in most districts. It gave only moderate results against the plum curculio [*Conotrachelus nenuphar*, Hbst.] and appeared relatively ineffective against the apple maggot [*Rhagoletis pomonella*, Walsh], the strawberry leaf roller [*Ancylis comptana*, Froel.], the lesser peach borer [*Aegeria pictipes*, G. & R.], the eye-spotted budmoth [*Spilonota ocellana*, Schiff.] and the common red spider [*Tetranychus*]. It gave excellent

control of the greenhouse leaf tier [*Phlyctaenia rubigalis*, Gn.] and thrips on greenhouse crops.

It is reported that the damage caused by the form of *Harmologa* (*Archips*) *fumiferana*, Clem., that attacks balsam [*Abies balsamea*] and white spruce [*Picea glauca*] in forests in Quebec and Ontario is increasing yearly [*cf.* **33** 143]. Preliminary investigations on the application of a concentrated spray of DDT from aeroplanes gave promising results against it. Infestations by the Jack pine budworm [the form of *H. fumiferana* that attacks *Pinus banksiana*] were found to extend from northern Saskatchewan through Manitoba and eastward beyond Lake Nipigon. Investigations on the rate of deterioration of yellow birch [*Betula lutea*] attacked by the bronze birch borer [*Agrilus anxius*, Gory] in the Maritime Provinces, showed the necessity for the earliest possible salvage in stands where a large proportion of the trees have some dead branches as well as weak tops ; exposure resulting from the cutting of pulpwood had no appreciable influence on deterioration [*cf.* **32** 110]. Investigations following a severe forest fire in 1942 in northern Saskatchewan showed that severely burned white spruce with the bark remaining was not attacked by wood-borers, while the least burned type (root-burn) was the last to be infested. Salvage operations during the second winter after the fire saved much timber, particularly root-burned trees, before the damage from borers reached its maximum. The total damage from wood-borers was complete in all types of burned trees during the third summer.

The most important pests of flour and cereal products in warehouses were spider beetles [Ptinids], which were most common and injurious in the Prairie Provinces. Insect infestation of grain in storage has decreased, partly because of the freer movement of stocks, but outbreaks of the rust-red grain beetle [*Laemophloeus ferrugineus*, Steph.] and mites still occur ; the chief methods of control are fumigation with chlorpicrin or carbon tetrachloride, and in most cases it is considered advisable to draw off the infested grain [*cf.* **33** 225]. Railway waggons used to carry infested grain from country districts are cleaned with compressed air after unloading, and the grain is all cleaned and, if necessary, fumigated. *Cynaeus angustus*, Lec., a pest of stored grain and other cereal products in Iowa and Kansas, was recorded from southern Saskatchewan for the first time in 1944.

A list is given of insects against which parasites were distributed during the year. *Lydella stabulans* [var. *grisescens*, R.-D.] and *Eulophus viridulus*, Thoms., introduced against *Pyrausta nubilalis*, extended their range in Ontario, and *Macrocentrus gifuensis*, Ashm., was reared and liberated against it in both Ontario and Quebec. The first known outbreak of Dutch elm disease [caused by the fungus, *Ceratostomella ulmi*] in Canada was reported from the Lake St. Peter section of Quebec in August 1944. About 8,000 traps for the Japanese beetle [*Popillia japonica*, Newm.] set up in Ontario and near Montreal in 1944 caught 189 beetles ; 57 more were taken in scouting operations at Hamilton, one from a car, two at an airport and one on an aeroplane at another airport [*cf.* **33** 137]. Late in the season, an outbreak was discovered in Halifax, Nova Scotia, and a survey resulted in the collection of 598 beetles. Sprays of lead arsenate were applied to the soil over about eight acres in New Toronto and six acres in Hamilton in autumn.

In the report of the Forest Nursery Station, Sutherland, Saskatchewan (pp. 129–131), it is recorded that *Caragana* sown in autumn in several plots in which it had been grown before was heavily infested by *Sitona tibialis*, Hbst. It is considered that infestation could be prevented by crop rotation and sowing in June away from *Caragana* hedges.

Blattný (C.), Novák (S.), Kac (A.) & Ryžkov (N.). **Zpráva o škodlivých činitelích obilovin a řepy, zelenin, pícnin a obchodních plodin, ovocných plodin a okrasných rostlin v Čechách ve vegetačním období 1938–1939.** [Report on adverse Factors affecting Cereals and Beet, Vegetables, Fodder and commercial Crops, Fruits and ornamental Plants in Bohemia during the Vegetation Period of 1938–39.]—*Ochr. Rost.* **16** pp. 5–18. Prague, 1940. (With a Summary in German.)

Blattný (C.), Novák (S.), Kac (A.), Starý (B.) & Ryžkov (N.). **Zpráva o škodlivých činitelích kulturních plodin (vyjma bramborů) ve vegetačním období 1939-40 v Čechách.** [Report on adverse Factors affecting cultivated Crops (with the exception of Potatoes) in the Vegetation Period 1939–40 in Bohemia.]—*Op. cit.* **17** pp. 5–13, 1 pl. 1941. (With a Summary in German.)

Blattný (C.), Novák (S.), Vielwerth (V.), Kac (A.), Starý (B.) & Ryžkov (N.). **Zpráva o škodlivých činitelích kulturních rostlin ve vegetačním roce 1940–41 v Čechách.** [Report on adverse Factors affecting cultivated Plants in Bohemia in the Vegetation Year 1940–41.]—*Op. cit.* **18** pp. 5–16. 1942. (With Summaries in German.)

These reports are similar to those of previous years [*cf. R.A.E.*, A **27** 468] and include brief notes on the occurrence of pests of cultivated plants in Bohemia in 1939–41. *Ceuthorrhynchus macula-alba*, Hbst., on poppies, *Cydia* (*Carpocapsa*) *pomonella*, L., on apple, and *Paratetranychus pilosus*, C. & F., on various fruit trees, particularly plums, were injurious in all three years, and the first generation of *Pegomyia hyoscyami* var. *betae*, Curt., was injurious to beet in 1939 and 1941. Infestation of apple by *Eriosoma* (*Schizoneura*) *lanigerum*, Hsm., was greatly reduced by severe frosts in 1939–40, but was becoming severe again in 1941, especially in the warmer districts. Other pests of importance in only one year included *Cydia* (*Grapholitha*) *funebrana*, Treitschke, on plums, *Lyonetia clerkella*, L., on cherries, *Hoplocampa testudinea*, Klug, and *Enarmonia* (*Grapholitha*) *woeberiana*, Schiff., on apples, and *Pyrausta nubilalis*, Hb., on hops, all in 1939. *Contarinia tritici*, Kby., on wheat, *C. medicaginis*, Kieff., on clover and lucerne, *Hylemyia* (*Chortophila*) *brassicae*, Bch., *Bibio marci*, L., *Tipula paludosa*, Mg., and Halticids on cabbage, *Tetranychus telarius*, L. (*Epitetranychus althaeae*, v. Hanst.) on greenhouse cucumbers, *Calocoris norvegicus*, Gmel., on poppies, *Psylla mali*, Schm., on apple and *Eulecanium* (*Lecanium*) *coryli*, L., on various fruit trees, especially plums, all in 1940 ; and *Stenothrips graminum*, Uzel, *Haplothrips aculeatus*, F., and *Limothrips denticornis*, Hal., on oats, *Otiorrhynchus singularis*, L., on apples and *Psylla pyricola*, Först., on pears, all in 1941.

Baudyš (E.). **Zpráva o škodlivých činitelích kulturních rostlin ve vegetačním období 1938–1939 na Moravě.** [Report on adverse Factors affecting cultivated Plants in Moravia during the Vegetation Period 1938–39.]—*Ochr. Rost.* **16** pp. 22–40, 2 figs. Prague, 1940. (With a Summary in German.)

Zpráva o škodlivých činitelích . . . 1939–1940. *Op. cit.* **17** pp. 19–34. 1941. (With a Summary in German.)

Rozsypal (J.). **Zpráva o škodlivých činitelích kulturních plodin (vyjma oves, brambory, len) ve vegetačním období 1940–41 na Moravě.** [Report on adverse Factors affecting cultivated Plants (with the Exception of Oats, Potatoes and Flax) during the Vegetation Period 1940–41 in Moravia.]—*Op. cit.* **18** pp. 17–24. 1942. (With a Summary in German.)

Pests of importance in Moravia in more than one of the years under review comprised : *Ceuthorrhynchus macula-alba*, Hbst., on poppy, and *Operophtera*

(*Cheimatobia*) *brumata*, L., on various fruit trees, in 1939, 1940 and 1941; *Eriosoma lanigerum*, Hsm., and *Anthonomus pomorum*, L., on apple, and *Eulecanium* (*Lecanium*) *coryli*, L., on plum, in 1939 and 1940; *Cydia* (*Carpocapsa*) *pomonella*, L., on apple, *Argyresthia ephippella*, F. (*pruniella*, auct.) on apple and pear, *Epidiaspis leperii*, Sign. (*betulae*, auct.) and *Psylla pyrisuga*, Först., on pear, *Hoplocampa minuta*, Christ (*fulvicornis*, F.) on plum, and *Pegomyia hyoscyami*, Panz., on beet, in 1940 and 1941; and *Chlorops pumilionis*, Bjerk. (*taeniopus*, Mg.) on wheat in 1940 and barley in 1941.

Those injurious in only one year included: *Pyrausta nubilalis*, Hb., on maize, *Hadena* (*Mamestra*) *trifolii*, Rott., on clover, *Meligethes aeneus*, F., on rape, *Tetranychus telarius*, L., on hops, *Lepidosaphes ulmi*, L., *Phenacoccus aceris*, Sign., and *Hyponomeuta padellus malinellus*, Zell., on apple, *Hyalopterus arundinis*, F., and *Anuraphis schwartzi*, Börn. (*Appelia amygdali*, Buckt.) on peach, *Eriophyes tristriatus* var. *erineus*, Nal., on walnut, *Pristiphora pallipes*, Lep., on gooseberries, *E. ribis*, Nal., on red currants, and *E. vitis*, Pgst., on grape vines, in 1939; *Toxoptera* (*Rhopalosiphum*) *graminum*, Rond., on wheat, *Bruchus pisorum*, L., on peas, *Contarinia onobrychidis*, Kieff., on sainfoin [*Onobrychis sativa*], *Argyresthia conjugella*, Zell., on apple, *Cydia* (*Grapholitha*) *funebrana*, Treitschke, on plum, and *Rhagoletis cerasi*, L., on cherries, in 1940; *Lema cyanella*, L., on barley, *Aphis* (*Doralis*) *fabae*, Scop., on broad beans, *Aprion apricans*, Hbst., and *Dasyneura leguminicola*, Lint., on clover, *D. ignorata*, Wachtl, on lucerne, *D. papaveris*, Winn., and *Stenocarus fuliginosus*, Marsh., on poppies, *Cydia* (*Grapholitha*) *dorsana*, F., and *Sitona lineatus*, L., on peas, *Crioceris asparagi*, L., on asparagus, *Macrosiphum pelargonii*, Kalt., on greenhouse cucumbers, *Aporia crataegi*, L., on apples and cherries, *Malacosoma neustria*, L., *Anthophila* (*Simaethis*) *pariana*, Cl., *Coleophora hemerobiella*, Scop., *Psylla mali*, Schm., and *Eriophyes pyri*, Pgst., on apple, *Enarmonia* (*Grapholitha*) *woeberiana*, Schiff., on apricots and peaches, *Aegeria* (*Sesia*) *tipuliformis*, Cl., on currants and gooseberries, *Lasioptera rubi*, Heeg., on raspberries, and *Rhynchites aeneovirens*, Marsh., on strawberries, in 1941.

Kalandra (A.) & Peeffer (A.). **Důležitější a pozoruhodnější poškození, choroby a škůdci lesních dřevin v roce 1939 v Protektorátě Čechy a Morava.** [The most important and noteworthy Injuries, Diseases and Pests of Forest Trees in the Year 1939 in the Protectorate of Bohemia and Moravia.] —*Ochr. Rost.* **16** pp. 40–45. Prague, 1940. (With a Summary in German.)

Kalandra (A.). **Důležitější . . . v roce 1940. . .**—*Op. cit.* **17** pp. 37–43. 1941. (With a Summary in German.)

Kalandra (A.). **Důležitější . . . v roce 1941.**—*Op. cit.* **18** pp. 33–38. 1942. (With a Summary in German.)

These surveys were compiled, as in previous years [*cf. R.A.E.*, A **27** 469], from reports and samples of material from Bohemia and Moravia. The pests are recorded under the trees attacked and brief notes are given on their local distribution and prevalence in 1939–41. Important pests that were present in all three years were *Chermes nordmannianae*, Eckstein (*Dreyfusia nüsslini*, Börn.) on silver fir (*Abies alba*), *Dendrolimus pini*, L., on pine, and *Epiblema tedella*, Cl., and *Lymantria* (*Liparis*) *monacha*, L., on spruce. Damage by *L. monacha* in 1940 and by all three moths in 1941 was reduced by parasites and disease among the larvae. The many pests recorded in one year only, most of which are well known in European forests, included *Argyresthia illuminatella*, Zell., which caused severe local damage in stands of *Abies alba* 30–50 years old in 1939.

MAGERSTEIN (Č.). **Škodliví činitelé košikářské vrby ve vegetačním období 1938–1939. (Se zvláštním zřetelem k výskytu na východomor. vrbařské oblasti.)** [Adverse Factors affecting Basket Willows in the Vegetation Period 1938–39. (With particular Regard to their Occurrence in East Moravian Willow-growing Areas.)]—*Ochr. Rost.* **16** pp. 45–49. Prague, 1940. (With a Summary in German.)

MAGERSTEIN (Č.). **Škodliví činitelé . . . 1939–40.**—*Op. cit.* **17** pp. 34–37, 1 pl. 1941. (With a Summary in German.)

The weather in Czechoslovakia in both 1939 and 1940 was unfavourable for the development of insect pests of willows, but the autumn of 1940 was warm and dry, and maturing willows were severely infested by several species of insects that are usually active in summer but developed late. Osier [*Salix viminalis*] was attacked by *Aphis* (*Doralis*) *saliçeti*, Kalt., the Noctuids, *Earias chlorana*, L., *Bombycia viminalis*, F., *Agrochola* (*Orthosia*) *lota*, Cl., and *A.* (*O.*) *circellaris*, Hfn., and the sawflies, *Cimbex lutea*, L. (*variabilis*, Klug) and *Pseudoclavellaria* (*C.*) *americana*, L., in 1939, the Galerucid, *Lochmaea capreae*, L., in 1940, and the Cercopid, *Aphrophora salicis*, Deg., the Notodontid, *Phalera bucephala*, L., and the Aphids, *Pterocomma bituberculata*, Theo., *P. flocculosa*, Wied., and *Lachnus salignus*, Gmel. (*Tuberolachnus viminalis*, Boy.) in both years. The so-called American willow [possibly a variety of *Salix purpurea*] was attacked by *Lochmaea cupreae* in 1939 and *Cryptorrhynchus lapathi*, L. [*cf. R.A.E.*, A **26** 658] and *Aphrophora salicis* in both years.

KRATOCHVÍL (J.). **Třásněnky brněnských skleníků a škody, které působí na skleníkových rostlinách.** [Thysanoptera occurring in Glasshouses at Brno and Injuries caused by them to the Glasshouse Plants.]—*Ochr. Rost.* **17** pp. 51–59. Prague, 1941. (With a Summary in German.)

A list is given of 16 species of thrips observed by the author on ornamental plants in glasshouses at Brno, Moravia, since 1933, together with notes on their appearance, relative importance, and food-plants. The most important were *Heliothrips haemorrhoidalis*, Bch., *Hercinothrips* (*H.*) *femoralis*, Reut., *Parthenothrips dracaenae*, Heeger, and *Scirtothrips longipennis*, Bagn., which bred throughout the year. The first three were polyphagous and the fourth occurred on leaves of palms. The other species were observed only during the vegetation period and only occasionally. Not all of them bred in glasshouses.

STARÝ (B.). **Nový škůdce máku.** [A new Pest of Poppy.]—*Ochr. Rost.* **17** pp. 88–90, 2 pls. Prague, 1941. (With a Summary in German.)

The Mirid, *Calocoris norvegicus*, Gmel., is common in Czechoslovakia, but little is known of its biology and it has not previously been recorded as a pest there. In July and August 1940, however, it was injurious to poppies in fields near Prague, feeding in numbers on the flower buds and young capsules and causing a reduction in the amount of seed. Its feeding resulted in dying of the plant tissues, which may have been due to a toxic substance in its saliva. Notes on its bionomics are given from the literature and its various food-plants are recorded. Control is difficult, since it is polyphagous and resistant to insecticides. The removal of plant remains from the infested fields might check its increase.

BLATTNÝ (C.), STARÝ (B.) & HERVERT (V.). **Zpráva o pokusech s hubením svilušky ovocné** (*Paratetranychus pilosus* **Can. et Fanz.).** [Report on Experiments in the Control of the Fruit Tree Red Spider.]—*Ochr. Rost.* **18** pp. 38–42. Prague, 1942. (With a Summary in German.)

Paratetranychus pilosus, C. & F., is an important pest of plums in Czechoslovakia and also infests apples, cherries and pears. Field and laboratory

experiments on the use of dormant sprays against the winter eggs of this mite have been carried out in Prague for several years, and the results are summarised in a table showing the sprays and concentrations used and the average rate of egg mortality over the whole period of the experiments.

Of the preparations tested, sodium silicate (water glass), Bordeaux mixture and milk of lime were ineffective, a preparation of barium polysulphides and another of colloidal sulphur gave only 35 and 58 per cent. mortality, tar distillates and lime-sulphur were also not highly effective, even at impracticably high concentrations, but a preparation containing 23 per cent. dinitro-ortho-cresol gave 95, 99 and 100 per cent. mortality at concentrations of 1·5, 2 and 3 per cent., respectively, without injuring the trees.

Tyburetz (F. W.). **Kvasia.** [Quassia.]—*Ochr. Rost.* **18** pp. 50–54, 2 figs., 13 refs. Prague, 1942. (With a Summary in German.)

The author gives a list of ten species of tropical Simarubaceous trees from which the insecticide known as quassia is obtained, and describes *Quassia amara* and *Picrasma excelsa*, which are the most important of them, with notes on their distribution and the physical characters of the wood. The chemical properties of the active principles contained in it, quassin, neoquassin and picrasmin, and the effect of quassin on insects are briefly discussed. The preparation of quassia infusions (usually from the wood chips) at home is not recommended, as micro-organisms soon develop in them and they decompose in a few hours [*cf. R.A.E.*, A **27** 46]. Officially approved proprietary preparations containing quassia are enumerated.

Blattný (C.). **Několik poznámek k pathologii kukuřice v Čechách.** [A few Notes on the Pathology of Maize in Bohemia.]—*Ochr. Rost.* **18** pp. 54–57. Prague, 1942. (With a Summary in German.)

It is stated in the course of this paper that *Pyrausta nubilalis*, Hb., is a serious pest of maize in Slovakia in some years, but does not attack it in Bohemia, though it is steadily increasing there on hops. Migration from hops to maize has not been observed, and it is suggested that a distinct race of the Pyralid may be involved.

Starý (B.). **Nový škůdce na lísce.** [A new Pest of Hazel.]—*Ochr. Rost.* **18** pp. 61–62, 1 fig. Prague, 1942. (With a Summary in German.)

Severe injury to cultivated varieties of hazel [*Corylus avellana*] in Prague and Southern Moravia was found in 1941 to be due to the Mirid, *Phylus coryli*, L. It fed on the young nuts at the end of April and on the lower surface of the leaves, causing both to dry up and fall. Previous failures to obtain a good crop may have been due to it. It was effectively controlled by applying a contact spray to the lower surface of the leaves. *P. melanocephalus*, L., was found with *P. coryli* on hazel in southern Moravia.

Kratochvíl (J.). **Naše zkušenosti se smutnicemi, škůdci žampionových kultur.** [Our Experiences with Mycetophilids, Pests of cultivated Mushrooms.]—*Ochr. Rost.* **18** pp. 72–76. Prague, 1942. (With a Summary in German.)

The most important pests of cultivated mushrooms in Moravia are species of *Sciara* (*Neosciara*) of which *S. fenestralis*, Zett. (*solani*, Winn.) has of recent years become the commonest. It constituted 90–100 per cent. of the flies of this genus taken in mushroom houses between 1936 and 1941, the others including *S. modesta*, Staeg., *S. nervosa*, Mg., and *S. praecox*, Mg. It occurs in large numbers in such habitats as caves and damp tree holes, where it thrives

on decaying vegetable matter overgrown with mould, and in experiments by the author in 1937, it bred rapidly in compost in narrow glass tubes at a relative humidity of 85–96 per cent. and a temperature of 9–18°C. [48·2–64·4°F.]. The optimum temperature and humidity were 12–15°C. [53·6–59°F.] and 93–95 per cent., and its development was retarded or ceased at humidities below 70 per cent. Observations on its bionomics in the mushroom houses, where it breeds continuously under favourable conditions, showed that the main damage is due to the destruction of mycelium by the larvae, though they sometimes also infest the caps of the mushrooms. The females laid 70–120 eggs singly or in batches, and the egg, larval and pupal stages lasted 3½–4, 10–15 and 4–5 days, respectively, at 12–15°C. and a relative humidity of 90–95 per cent., and 6–7, 12–20, and 6–8 days, at 20°C. [68°F.] and 60–70 per cent. humidity. The adults apparently survived for 3–9 days.

Control is difficult. The measures recommended, in addition to those already noticed [*R.A.E.*, A **31** 109; *cf.* also **20** 301], include the fumigation of cellars, in which mushrooms are to be grown, with sulphur or washing them out with a disinfectant, allowing the manure to heat for several days before use and discarding the upper layers, and screening ventilators and other openings with wire gauze.

ROZSYPAL (J.). **Roztoč kořenový, škůdce letošních ozimů.** [The Root Mite, Pest of this Year's Autumn-sown Crops.]—*Ochr. Rost.* **18** pp. 76–78. Prague, 1942. (With a Summary in German.)

Rhizoglyphus echinopus, Fum. & Rob., was abundant in the spring of 1941 near Brno (Moravia) on rye and wheat that had been sown in the preceding autumn. The mites fed on the stems and sheaths, and the lower part of the leaves, and all stages occurred in the sheaths. As a result, the lower part of the stem became brown, the leaf-sheaths acquired a ragged appearance, and growth was retarded. Some of the plants were killed, and some that survived produced white ears. Infestation was particularly heavy on plants growing on soil covered with a hard crust that prevented aeration. The control measures recommended are the use of fertilisers to encourage plant growth and cultivation of the soil to admit air.

BLATTNÝ (C.) & STARÝ (B.). **Poškození bramborových listů od ploštic.** [Injury to Potato Leaves by Bugs.]—*Ochr. Rost.* **18** p. 201, 1 fig. Prague, 1942. (With a Summary in German.)

Injury to the leaves of potato that is common in parts of Czechoslovakia was found in the summer of 1941 to be caused by the feeding of *Calocoris norvegicus*, Gmel., and *C. biclavatus*, H.-S. These Mirids occur on various cultivated and wild plants and migrate to potato in warm summers. They feed on the main leaf veins, causing the leaves to wither and fall.

KOTTE (W.). **Krankheiten und Schädlinge im Gemüsebau und ihre Bekämpfung.** [Diseases and Pests of Vegetables and their Control.]—9¼ × 6½ ins., viii + 244 pp., 8 col. pls., 169 figs., refs. Berlin, P. Parey, 1944.

This handbook was compiled to explain to growers in Germany modern methods of controlling common insect, fungous and other pests and diseases of vegetables with which they are likely to have to deal and the biological foundations on which such methods are based. The pests and diseases dealt with are largely those of importance in south-western Germany. Following an

introductory chapter on the economic importance of plant protection, there are two sections in which the chief groups of pests are reviewed and notes are given on the kinds of injury caused to various crops by individual pests and, in the case of insects, their appearance and life-history. Control measures are suggested for each, and there is a further section in which these are considered at length and classified, with notes on the preparation and use of various insecticides and fungicides. A key is included for the determination of the most important pests and diseases of each crop, largely by the kind of injury caused, together with a programme of work, including control measures, to be carried out in each month.

BERGAMIN (J.). **O " repasse " como método de controle da broca do café *Hypothenemus hampei* (Ferr., 1867) (Col. Ipidae).** [A Method of Control of the Coffee Borer, *Stephanoderes hampei*.]—*Arq. Inst. biol.* **15** pp. 197–208, 2 figs., 8 refs. São Paulo, 1944. (With a Summary in English.)

As females of *Stephanoderes* (*Hypothenemus*) *hampei*, Ferr., in coffee berries live for an average period of 156 days [*R.A.E.*, A **33** 203], they can survive from one coffee crop to the next in fruits left on the trees or on the ground, though they breed in them only if the humidity is high. They cannot survive so long in the absence of coffee berries, and the removal of all berries left after harvest is one of the measures recommended for the control of the Scolytid in São Paulo [*cf.* also **10** 506; **11** 240; **12** 203]. Experiments to test its effectiveness were carried out in 1942–43 and 1943–44 and are described in detail. The treatments tested were the removal of the berries from the trees only, their removal from the ground only, by raking and sweeping, and a combination of both. The percentages of infested berries in the succeeding crop were then calculated. The results are presented in tables and analysed statistically. The combined treatment gave highly significant reductions in all cases, as compared with the controls. Collection from the ground only also gave a highly significant reduction on large leafy trees in full production, but was not significantly better than no treatment on decadent trees with few leaves that afforded little shade [*cf.* **28** 61]. Collection from the trees only gave a significant reduction on the leafy trees and in one of the two tests on the decadent ones. There were no significant differences between treatments.

Though the combined treatment thus gave the best results, collection from the ground only would be of value in a commercial plantation, especially if it were supplemented by distribution of *Prorops nasuta*, Wtstn., which parasitises the borer in berries on the tree [*cf.* **32** 110].

DE FIGUEIREDO jr. (E. R.) & PEREIRA (H. F.). **Notas sôbre *Xanthopastis timais* (Cram.) (Lep. Noct.), praga das Amarilidáceas.** [Notes on *X. timais*, a Pest of Amaryllidaceae.]—*Arq. Inst. biol.* **15** pp. 289–298, 15 figs., 3 refs. São Paulo, 1944. (With a Summary in English.)

The Noctuid, *Xanthopastis timais*, Cram., all stages of which are described, is a serious pest of *Amaryllis* spp. and other ornamental plants of the same family, including *Hacmanthus fascinator*, *Eucharis grandiflora*, *Clivia* spp. and *Hippeastrum* spp., throughout Brazil. The egg, larval and pupal stages lasted 5, 25 and 20 days, respectively, in the laboratory, at an average temperature of 22–23°C. [71·6–73·4°F.], and the adults lived for 8–10 days. The eggs were laid in groups of 17–232, usually on the lower surface of the leaves. The larvae passed through six instars, feeding gregariously on the leaves during the first five and separating at the sixth, and pupated in the soil. A spray of 3 lb. lead arsenate per 100 gals. water was ineffective against them [*cf.* *R.A.E.*, A **31** 476], but proved satisfactory when 2 lb. Paris green was added to it.

ZIKÁN (W.). **Notas sôbre** *Lonchaea pendula* **(Bezzi) (Diptera) e** *Belonuchus formosus* **Gravenh. (Staphylinidae, Coleoptera).** [Notes on *L. pendula* and *B. formosus*.]—*Bol. Minist. Agric.* **32** no. 9 pp. 1–10, 2 figs. Rio de Janeiro, 1944.

In the State of Rio de Janeiro, *Lonchaea pendula*, Bez., is a secondary pest in various fruits, including those of mamey (*Mammea americana*), *Eugenia* sp., mango and orange, and a primary pest in shoots of cassava. The adults were observed in one locality depositing their eggs singly, deep in lesions caused in orange fruits by *Leptoglossus gonagra*, F. [*cf. R.A.E.*, A **30** 98], but this Coreid did not attack oranges in another locality in which it caused considerable damage to *Sechium edule*. *Lonchaea pendula* was not common in oranges previously attacked by *Ceratitis capitata*, Wied., and *Anastrepha fraterculus*, Wied., and this was found to be due to the presence of a predacious Staphylinid, *Belonuchus rufipennis*, F. (*formosus*, Grav.), a description of the adults of which is quoted, with a note on its distribution in Brazil. Its habits were studied in cages, and it was found that larvae and adults died in 4–5 days when confined with uninfested rotting oranges, but thrived when the oranges were infested with larvae of various flies and beetles, showing that both larvae and adults are predacious. This behaviour is similar to that of *B. latro*, Erichson, which was found in infested oranges nearly 2,300 ft. above sea-level. Larvae and adults of *B. rufipennis* were also found in tobacco from which the nicotine had been extracted and which was heavily infested by Dipterous larvae. Most Staphylinids inhabit damp and shady spots on the ground, where Dipterous larvae are common, but the winged species visit higher sites, and *B. rufipennis* was observed on an Annonaceous fruit infested with larvae of the Tineid, *Cerconota anonella*, Sepp, and other insects, growing 3 ft. above the ground.

On cassava, *Lonchaea pendula* inserts its eggs partly into the tips of the terminal shoots. The larvae feed in the shoots, causing them to wither and possibly facilitating the entry of fungi. They were not attacked by *B. rufipennis*, possibly because the shoots have no attractive odour. Larvae of *Anastrepha manihoti*, Costa Lima, were observed for the first time in the shoots of cassava, having previously been known only as a pest of the fruits. The only control measures recommended against *Lonchaea* are the destruction of infested shoots and the use of bait traps against the adults. A list is given of the various plants attacked by it in different months in the Federal District and State of Rio de Janeiro.

MACEDO (A.). **Pelo aumento da produção do coqueiro no Paraíba.** [How to increase the Productivity of Coconut Palms in Paraíba.]—*Bol. Minist. Agric.* **32** no. 9 pp. 27–44, 4 figs., 7 refs. Rio de Janeiro, 1944.

This paper includes notes on the bionomics and control of several insects that attack coconut (*Cocos nucifera*) in the State of Paraíba. Considerable injury is caused by the weevils, *Rhynchophorus palmarum*, L., *Rhina barbirostris*, F., and *Homalinotus* spp., chiefly *H. coriaceus*, Gylh. [*cf. R.A.E.*, A **10** 53; **11** 120]. *Rhynchophorus* can be controlled by collecting it from baits formed of pieces of dead or felled palm distributed through the plantations, *Rhina* by killing the larvae with a wire or destroying infested palms, and *Homalinotus* by the removal of native palms, clean cultivation, hand-collection of adults and the use of a dust or 2 per cent. spray of Paris green against the larvae. Larvae of the Dynastids, *Strategus aloeus*, L., and *S. anachoreta*, Burm., mine in the roots and trunks; they should be removed by means of a wire, but badly infected palms must be destroyed. Pests that attack the leaves include an unidentified Saturniid and Brassolids, including *Brassolis sophorae*, L., which is the most serious pest of coconut in the State. The larvae of *Brassolis* congregate during the day in shelters [*cf.* **23** 60] and can easily be collected and destroyed by the pickers.

Sprays of 1 lb. lead arsenate and 1 lb. molasses per 100 gals. water, or 1 lb. Paris green, 2½ lb. quick-lime and 10 lb. wheat flour per 100 gals., are recommended, especially for dwarf palms. The Hispid, *Coraliomela brunnea*, Thnb., owing to its weak powers of flight, chiefly infests dwarf palms. The larvae feed among the young leaflets, and even two or three can cause serious damage to a palm. Hand-collection or a spray of 2 per cent. Paris green are suggested for control. The palms are also attacked by Aphids, Aleurodids, Pentatomids and Coccids, including *Aspidiotus destructor*, Sign., which feeds on the lower sides of the leaves. The treatment recommended against all these is spraying fortnightly, in the cool of the day, with an oil emulsion.

Soares Brandão filho (J.). **As brocas da aboboreira.** [Squash Borers.]—*Bol. Minist. Agric.* **33** no. 6 pp. 81–85, 2 figs. Rio de Janeiro, 1945.

The foliage and fruits of squash and other cucurbits in Brazil are attacked by *Diaphania nitidalis*, Stoll, and *D. hyalinata*, L. Descriptions of the larva and adult of the former and the adult of the latter are quoted from the literature, together with notes on their bionomics. In the State of Rio de Janeiro, the larvae appear during the rainy season (October–February). Infestation can be controlled by spraying at intervals of 20 days, from the time when the first larvae hatch until the rind of the fruits has grown sufficiently tough to resist attack, and formulae are given for preparing suitable sprays containing lead arsenate, calcium arsenate or nicotine sulphate, which also destroys the eggs. *Cucurbita moschata* has been recommended as a trap crop. Cultivating the soil to expose the pupae to predators and to the effects of weather affords some control during an outbreak.

de Toledo (A. A.). **Emulsões compatíveis com os inseticidas de ingestão.** [Emulsions compatible with insecticidal Stomach Poisons.]—*Biológico* **11** no. 7 pp. 177–181. São Paulo, 1945.

The effectiveness of many insecticidal sprays is increased by the addition of oil as an adhesive, but an emulsifier for the oil is necessary. Milk, whole or skimmed, fresh or boiled, is particularly suitable in country districts, since it can emulsify animal, vegetable or mineral oil, and the resulting emulsion is chemically compatible with any stomach insecticide. This is also true of yolk and white of egg, used separately or together. For an arsenical spray, with linseed oil, the quantities recommended are 10 lb. arsenate and 5 lb. oil, with 2 gals. milk and 98 gals. water or 1 lb. egg-yolk and 100 gals. water. The oil and milk or egg are first mixed, the water is added gradually with constant stirring, and finally the insecticide.

Experiments were carried out in the laboratory in Brazil to ascertain whether linseed-oil emulsion prepared in this way would reduce the toxicity of various insecticides. They showed that it had little effect on the time required by sprays of calcium arsenate, cryolite, barium fluosilicate or DDT to give complete mortality of larvae of *Heliothis armigera*, Hb. (*obsoleta*, F.) on maize, and similar results were obtained with sprays of calcium arsenate and cryolite against larvae of *Eutinobothrus* (*Gasterocercodes*) *brasiliensis*, Hambleton, on cotton stalks and calcium arsenate, lead arsenate and Paris green against *Epicauta atomaria*, Germ., on *Amarantus* sp.

Lepage (H. S.) & Giannotti (O.). **Experiências preliminares de alguns inseticidas no controle de várias lagartas daninhas.** [Preliminary Experiments with certain Insecticides for the Control of various harmful Larvae.]—*Biológico* **11** no. 7 pp. 182–186. São Paulo, 1945.

Preparations containing synthetic organic insecticides were tested in the laboratory in São Paulo against last-instar larvae of *Alabama argillacea*, Hb.,

Erinnyis ello, L., and *Ascia monuste*, L., which damage cotton, cassava and cabbage, respectively, and *Laphygma frugiperda*, S. & A., and *Mocis repanda*, F., both pests of maize and grasses. In one series of tests, 20–40 larvae of each species were placed on wire gauze, sprayed with insecticide for 15–20 seconds and, one hour later, when the spray had dried, removed to untreated plants. The percentage mortalities 48 hours later for a spray containing 1 per cent. Gesarol M-10 (10 per cent. DDT in an inert carrier), alone and (in brackets) with 0·3 per cent. soap powder, were 85 (100) of *Laphygma*, 90 (100) of *Ascia* and 75 (95) of *Mocis*, but 0 (0) of *Alabama* and *Erinnyis*, against which sprays of 4 and 8 per cent. Gesarol M-10 were also completely ineffective. Sprays containing dinitro-o-cyclohexylphenol and phenothiazine had no effect on any of the larvae when applied in this way. When larvae of *Alabama* and *Erinnyis* were placed on plants previously sprayed and allowed to dry, Gesarol M-10 at 1 per cent. was repellent to *Alabama* [*cf. R.A.E.*, A **33** 289] and 0·1 or 0·2 per cent. dinitro-o-cyclohexylphenol and 0·1 per cent. phenothiazine were ineffective against it, but 0·05 per cent. of the phenol gave complete mortality of *Erinnyis* as compared with 20 per cent. for the DDT spray. The resistance of *Alabama* to DDT was confirmed by applying 0·01 cc. of various concentrations of pure DDT in acetone to the backs of the larvae by means of a pipette. Concentrations of 1 : 250 and 1 : 100 gave 0 and 10 per cent. mortality, respectively, in 24 hours, as compared with 73, 85, 90 and 100 per cent. for concentrations of 1 : 4,000, 1 : 2,000, 1 : 1,000 and 1 : 500 in a similar test with *Mocis*. Acetone alone was harmless to both species.

In the field, a spray of 1 per cent. Gesarol M-10 gave satisfactory results against *Laphygma* and *Mocis* on grasses and *Ascia* on cabbage. When cassava infested by *Erinnyis* was sprayed with 0·1 and 0·05 per cent. dinitro-o-cyclohexylphenol, 1 per cent. Gesarol A-5 (5 per cent. DDT) and 0·3 per cent. Paris green, rain completely washed the desposits off the plants in 20 hours, but the dinitro sprays gave 93 and 65 per cent. mortality, respectively. The others were effective only against the early larval instars.

Carvalho (J. C.). **O combate às formigas.** [The Campaign against Ants.]—*Biológico* **11** no. 8 pp. 227–231, 2 figs. São Paulo, 1945.

This is an account of work carried out during 1940–42 in the campaign against leaf-cutting ants [chiefly *Atta* spp.] in four districts of the State of São Paulo [*cf.* also *R.A.E.*, A **34** 334]. Carbon bisulphide was introduced into the nests through a series of holes drilled by means of a special tool [**29** 40]. Local workers were instructed in the methods to be employed, and over 16,000 nests were destroyed. The cost of materials and labour is discussed.

Salt (R. W.) & Seamans (H. L.). **Experimental Starvation of first-instar Larvae of the Pale Western Cutworm,** *Agrotis orthogonia* **Morr.**—*Canad. Ent.* **77** (1945) no. 8 pp. 150–155, 1 fig., 2 refs. Guelph, Ont., 1946.

The practice of freeing the soil from all plant growth for ten days after the larvae of *Agrotis orthogenia*, Morr., have hatched and fed for some time on weeds and self-sown grain [*cf. R.A.E.*, A **25** 754] has given excellent control of the cutworm during the three years that it has been tried in western Canada. Laboratory experiments to compare the mortalities of first-instar larvae starved before or after they have fed are described.

The larvae were reared individually in salve tins from the time of hatching, and the food used was the leaves of young wheat. Moisture was supplied, to prevent the food becoming dry, and control series were fed continuously. The experimental series were starved for a period of ten days immediately after hatching or after feeding for a preliminary period of five days, and in the case of those that fed, moisture was provided during the starvation period. Effective mortalities were calculated from Abbott's formula [**13** 331].

At about 13°C. [55·4°F.], effective mortality of starved larvae began in both groups on the eighth day, but it had reached a maximum of 77·9 per cent. in 15 days among the larvae that had fed before being starved, and 46·3 per cent. in 17 days among those that had not. At alternating temperatures of about 8°C. [46·4°F.] for 18 hours and 21°C. [69·8°F.] for six hours, it began on the seventh day, was 54·8 per cent. in 14 days, and reached a maximum of 61 per cent. in 24 days for larvae starved immediately after hatching, and began on the sixth day and reached a maximum of 85·4 per cent. in 13 days, for those that had fed previously. The increased mortality of larvae fed before starvation was apparently due to a digestive disturbance that prevented them feeding after they had been starved, since only 28 per cent. of the larvae at both temperatures did so, as compared with 62 per cent. of the larvae that had not fed before starvation. When moisture was also supplied during the period of starvation to larvae kept at 13°C. without preliminary feeding, effective mortality closely paralleled that of the corresponding larvae that fed before being starved up to the 14th day, but rose to a maximum of 87·8 per cent. in 20 days.

Observations suggest that the first-instar larvae in the field feed and move about mostly on the surface of the ground. When their food is destroyed by cultivation, they still remain on or close to the surface, and if they descend below the surface of moist soil they will apparently meet with conditions that will kill 80–90 per cent. of them whether they have fed or not.

GORHAM (R. P.). **The Use of Flight Traps in the Study of Aphid Movement.**—*Acadian Naturalist* **2** no. 6 pp. 106–111. Fredericton, N.B., 1946.

In connection with the survey of potato Aphids in eastern Canada [*cf. R.A.E.*, A **35** 11, etc.], a study of their flight movements by means of traps was begun in 1941. The sheets of wire gauze covered with an adhesive that were first used proved unsatisfactory owing to the difficulty of removing and identifying the specimens, and in 1942 a new type of trap designed by W. A. Shands was introduced. This consisted of a light iron frame covered with bobinette and resting upon a ball-bearing so that it would turn to face the direction of the wind at all times; the insects entered through an opening 20 ins. square, alighted on the cotton and crawled upward through an opening 4 ins. in diameter into a removable cap, from which they were subsequently collected. Traps were set up in New Brunswick, Quebec and Prince Edward Island in 1942, and their use was extended to Nova Scotia in 1943, Grindstone Island, in the Magdalen Islands, in 1944 and Newfoundland in 1945. The results are given for each of the years 1942–44, during which period about 170,000 insects were caught, including 12,927 examples of *Macrosiphum solanifolii*, Ashm., 17,388 of *Myzus persicae*, Sulz., 30,928 of *Aphis rhamni*, Boy. (*abbreviata*, Patch) and 163 of *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theo.). The records showed that some of the Aphids were in flight on every fine day in late July and throughout August, that mass migrations occurred at certain periods, and that the Aphids tended to be carried by currents of air in the late afternoon and early evening, which conveyed them to high altitudes and over wide forest and water barriers [*cf.* **35** 12, etc.].

KNOWLTON (G. F.). **DDT and Bees.**—*Mimeogr. Ser. Utah agric. Exp. Sta.* no. 321, 1 p. Logan, Utah, 1946.

A statement by J. I. Hambleton, Chief of the Division of Bee Culture, U.S. Bureau of Entomology and Plant Quarantine, summarises the results of laboratory experiments [*R.A.E.*, A **32** 387] and field observations on the effect of DDT on honey-bees. Colonies in cotton fields in Texas and lucerne fields in Arizona that were dusted from aircraft with 10 per cent. DDT at a rate of about 15 lb. per acre showed no ill effects, and one in a hive, the entrance of which was

heavily dusted with DDT, appeared normal several weeks after the application. A colony in a forest in Pennsylvania that was sprayed with DDT appeared unharmed, and bees collected in Canada from flowers of buckwheat that had been sprayed with DDT survived as long as others from unsprayed flowers. No complaints from bee-keepers were received during large-scale trials of DDT in potato fields in Washington. It is possible that results may vary in different localities, but as fewer applications of DDT than of arsenical insecticides are necessary, its use should be no more hazardous and may be less. It may even be of value to bee-keepers if it is more effective than arsenicals against insects injurious to honey-plants.

DDT Residue Tolerance announced.—*Ill. Hort.* **35** no. 1 pp. [4–5.] Quincy, Ill., 1946. [Quoted for the most part from *Bull. nat. Apple Inst.* no. 225, 1945.]

A provisional residue tolerance for DDT on apples and pears of 7 parts per million, equivalent to 0·05 grain per lb. fruit (the same as for lead), has been announced by the Food and Drug Administration of the United States. As no means is available of removing DDT from apples without damaging them, the quantity left on the fruit is likely to be determined solely by the spray programme adopted. In preliminary tests, the final residue on fruit that received 2, 4–5 or 6–8 cover sprays containing DDT were slightly less than 7, slightly less than 10, and about 13 p.p.m., respectively, and in other tests, the tolerance was not exceeded when DDT was applied seven times at a concentration of 6 oz. per 100 U.S. gals. with oil, but was when the concentration was increased to 1 lb. per 100 U.S. gals. Instructions for the determination of DDT residues on apple can be obtained from the Food and Drug Administration; the method of analysis is primarily a test for the chlorine part of the DDT molecule, which can be detected at harvest, although its insecticidal effect is apparently lost a few weeks after application.

Investigations with DDT in California, 1944. A preliminary Report prepared under the Direction of the Division of Entomology and Parasitology.—[2+] 33 pp., 2 figs., 3 refs., multigraph. Berkeley, Calif., Calif. agric. Exp. Sta., 1945.

In addition to the papers noticed below, this report includes an introduction in which the properties and insecticidal action of DDT are briefly discussed, and a list is given of code numbers applied to the forms in which it was used in most of the experiments. These include GNB-A (commercial pure DDT), A3 (3 per cent. DDT dust), A20 (20 per cent. DDT with wetting agent), AK20 (20 per cent. DDT without wetting agent) and SH20 (20 per cent. DDT in emulsive oil base).

Michelbacher (A. E.), Smith (R. F.) & Smith (G. L.). **Control of *Lygus* Bugs on Alfalfa Seed Crop with DDT,** pp. 4–6, 1 fig. A DDT dust (A3) was applied on 26th July at about 28 lb. per acre to a two-acre plot in a field of lucerne, grown for seed, that was heavily infested with *Lygus hesperus*, Knight, with small numbers of *L. elisus*, Van D. Two days later, the *Lygus* population was 90 per cent. less on the dusted than on the undusted part of the field. Lepidopterous larvae were also killed, but bees and *Melanoplus differentialis*, Thos., which were abundant, were not affected. During the next fortnight, the Mirids increased on the experimental plot, but only to an extent proportional to the increase on the control area, and adults were more numerous than nymphs; very young nymphs were not observed in the dusted plot until 9th August, when the population, though much smaller than that in the control area, was large enough to affect seed production. A second application on 12th August caused a marked reduction by 16th August, and almost complete elimination of

the younger nymphs. On 22nd August, populations in the dusted plot were still small and those in the remainder of the field were decreasing, possibly owing to natural enemies ; a later slight increase in the dusted plot, where the plants had more blossom than those outside, is attributed to immigration. The seed in the plot was ready for harvest by 1st October, and some seed was set in the rest of the field between 15th September and 7th October. The yields of clean seed from the two areas were estimated at 400 and 150 lb. per acre, respectively.

Swanson (C. H.) & Michelbacher (A. E.). **The Use of DDT on Almond Trees,** pp. 6–7. A DDT spray (5 lb. AK20 and 4 oz. blood albumin in 100 U.S. gals. water), applied to three almond trees on 26th June gave inconclusive results against *Scolytus rugulosus*, Ratz., and heavy infestation by the brown almond mite [*Bryobia praetiosa*, Koch] and the two-spotted mite [*Tetranychus bimaculatus*, Harvey] developed on the sprayed trees and eventually defoliated them ; the mite population also increased on neighbouring trees, doubtless owing to migration from the sprayed ones.

Borden (A. D.) & Jeppson (L. R.). **Tests with DDT on Larvae of Fruit Tree Leaf Roller and Tussock Moth attacking Apple,** p. 7. When a DDT spray (5 pints SH20 in 100 gals. water) was applied to apple trees infested with larvae of *Tortrix* (*Archips*) *argyrospila*, Wlk., and *Hemerocampa vetusta*, Boisd., on 1st May, the larvae left the foliage shortly afterwards and none was observed on the trees 48 hours later. The spray caused spotting of the leaves.

Smith (L. M.). **Laboratory Tests with two Berry Insects,** p. 7. Adults of *Paria canella*, F., and *Pantomorus godmani*, Crotch, were all dead in five days when caged with unsprayed strawberry leaves on a glass plate on which a DDT suspension (4 lb. A20 per 100 U.S. gals. water) had been poured 291 days before or on a glass plate bearing a newly-formed, thin deposit of a DDT dust (A3).

Smith (G. L.). **Control of certain Cotton Insects with DDT,** pp. 7–8. A DDT dust (A3) applied on 18th May at a rate of 25–30 lb. per acre to cotton plants 5–6 ins. high gave complete control of *Thrips tabaci*, Lind., *Frankliniella occidentalis*, Perg., and *Psallus seriatus*, Reut., within 24 hours, but had no effect on *Tetranychus atlanticus*, McG., and cotton Aphids [*Aphis gossypii*, Glov.]. A second application made on 18th July against *Lygus hesperus*, Knight, when no nymphs and only a few adults were present, gave complete mortality in 24 hours. Honey-bees did not as a rule alight on the dusted surfaces, but those that did appeared to be unaffected by the DDT. Adults of *L. hesperus* alighted on the leaves, but did not attempt to feed ; their movements became abnormal after a few seconds, although they were still able to fly a distance of 40–50 ft. The predators, *Geocoris pallens*, Stål, and *Nabis ferus*, L., behave similarly ; none of the former and only a few of the latter were present 24 hours after treatment. The treated plants produced 1 per cent. more seed cotton than the controls, but the difference was not significant. In another experiment, insects often found on cotton were swept from lucerne, lightly dusted with the DDT dust in the net and kept with lucerne cuttings overnight. This treatment did not affect *Chlorochroa sayi*, Stål, *Thyanta custator*, F., or *Melanoplus differentialis*, Thos., but gave complete mortality of *L. hesperus*, *Thrips tabaci*, *F. occidentalis*, *Empoasca* sp., and *Diabrotica undecimpunctata*, Mannh., and some mortality of *Hercothrips fasciatus*, Perg. About 50 per cent. of the larvae of *Prodenia praefica*, Grote, became shrivelled and none of these fed during an observation period of 24 hours.

Frazier (N. W.) & Stafford (E. M.). **Experiments with DDT against the Grape Leafhopper,** pp. 9–11. The grape leafhopper, *Erythroneura elegantula*, Osborn, is an important pest of vines in the San Joaquin Valley and is stated to be the Jassid erroneously recorded from this region as *E. comes*, Say, which occurs east of the Rocky Mountains. Vaporised sprays of DDT at concentrations of 1·2 and 0·6 per cent. in a vapo-spray base oil (10 per cent. light summer oil and 90 per cent. kerosene) and dusts prepared from 50 per cent. commercial

dusting sulphur and enough AK20 in Frianite to give 5, 3 and 1 per cent. DDT were applied at rates of $1\frac{3}{4}$ U.S. gals. and 20 lb. per acre, respectively, to infested vines on 5th May. On 9th May, before the nymphs had hatched, the numbers of overwintered adults were reduced by 98·3, 89·1 and 98·9 per cent. on the variety (Emperor) sprayed with 1·2 per cent. DDT and the two others (Red Malaga and Ribier) sprayed with 0·6 per cent. DDT, respectively ; the inferior result on Red Malaga is attributed to less satisfactory coverage due to its dense upright foliage. The percentages of dead nymphs were 4·5, 2·3 and 59·1, respectively, on 15th May and 55, 9·5 and 67·3 on 23rd. The dusts were applied to the variety Ribier only, and 5, 3 and 1 per cent. DDT gave 87·5, 64 and 7·1 per cent. reduction in numbers of adults, respectively, by 9th May, 83·7, 94·8 and 18·5 per cent. dead nymphs on 15th May and 93·8, 73·9 and 17·3 per cent. on 23rd May. On 13th June, when the population consisted chiefly of first-generation nymphs and adults and little migration had occurred, the leafhoppers were least numerous (0·07 per leaf) on the vines sprayed with 1·2 per cent. DDT, but the 5 and 3 per cent. dusts and the 0·6 per cent. spray on Ribier, which has less dense foliage, also gave moderate control (less than 1 leafhopper per leaf). By 2nd September, most of the toxicity was lost, but differences due to treatments still persisted.

Jeppson (L. R.) & Borden (A. D.). **Tests with DDT and other Insecticides for controlling Onion Thrips in the San Joaquin Delta,** pp. 11–14. A DDT dust (A3) and DDT sprays (SH20 and A20) applied on 24th May against *Thrips tabaci,* Lind., on onions in experimental plots appeared to be more effective than sprays containing rotenone or the dicyclohexylamine salt of dinitro-o-cyclohexylphenol, and the dust applied to young onions at 50 lb. per acre on 1st June was rather more effective over a period of three weeks than one applied at the same rate and containing 1 per cent. DDT (GNB-A) dissolved in methyl naphthalene and atomised on pyrophyllite ; a 1 per cent. dust in which the DDT was dissolved in acetone and atomised on pyrophyllite lost much of its toxicity in 14 days. A DDT spray (5 lb. AK20 and 4 oz. sodium oleyl sulphate per 100 U.S. gals. water) applied at 200 U.S. gals. per acre to late onions on 23rd June or 5th July or on both dates was more promising than sprays of tartar emetic and sugar, or nicotine sulphate and soap or one containing proprietary insecticides, including the dinitro compound, and other ingredients, all applied on both dates. There was no significant difference in the control given by the other sprays in June, but nicotine sulphate and soap was the most effective of them in July, when the temperature was high. In another experiment, young onions were sprayed on 26th June and 12th July with a DDT spray (5 lb. AK20 alone or with 1 lb. soap per 100 U.S. gals. water) or on these dates and 31st July with a weaker spray (2 lb. AK20), all at 220 U.S. gals. per acre. There was little difference in the effectiveness of the treatments and all were superior to a spray of 1 U.S. pint nicotine sulphate and 1 lb. soap per 100 U.S. gals. applied three times to the rest of the field. Plants treated with DDT remained green for about a fortnight longer and yielded 7,000–8,700 lb. more onions per acre than those treated with nicotine. One of the plots sprayed with DDT became heavily infested at the beginning of August, probably owing to migration from the area treated with nicotine, in which the foliage was withering.

Lange jr. (W. H.) & Thwaits (T. W.). **Tests with DDT and other Insecticides for controlling Onion Thrips in the Salinas Valley,** pp. 14–17. In experiments against *Thrips tabaci,* Lind., on onions, an emulsion of 1 per cent. of a concentrate containing 15 per cent. DDT (GNB-A), the preparation of which is described, proved much more effective than sprays containing other insecticides and somewhat more so than a DDT dust (A3). The treatments were applied on 21st July and 23rd August, and the DDT spray reduced the numbers of nymphs by 98·7 and 61·8 per cent. one and three weeks after the first application, and by 85·1 per cent. about three weeks after the second, and increased

the yields. A residue left on the foliage and bulbs was removed when the bulbs were peeled.

Borden (A. D.) & Jeppson (L. R.). **Field Tests with DDT to control Codling Moth on Bartlett Pears,** pp. 17–18. Pear trees that had been sprayed twice with lead arsenate were sprayed with DDT (5 U.S. pints SH20 or 5 lb. A20 per 100 U.S. gals. water) on 5th May and again on 22nd May, 14th June or 6th July, or on all four dates, against the codling moth [*Cydia pomonella*, L.]. No damage was found on either harvested or dropped fruits, but infestation in fruits from neighbouring trees that had received seven applications of lead arsenate did not exceed 2 per cent. The first spray (SH20) gave excellent coverage and caused no visible injury to the trees, but the second (A20) had poor wetting properties and caused spotting of the leaves and abnormal fruit drop. Injury by Tetranychid mites appeared earlier and was more severe on trees sprayed with DDT than elsewhere in the orchard ; eggs of Coccinellids and Chrysopids were not observed on the trees until a few weeks before harvest. When compared with the tolerance for lead [*cf. R.A.E.*, A **35** 110], all DDT deposits at harvest were below the permissible amount.

Borden (A. D.) & Jeppson (L. R.). **DDT Test in the Control of Pear Bud Mite,** p. 18. A DDT spray (5 lb. AK20 and 4 oz. sodium oleyl sulphate per 100 U.S. gals. water) applied on 2nd October to six pear trees heavily infested with the pear bud mite [*Eriophyes pyri*, Pgst.] under the first bud scales had apparently caused no mortality a week later.

Borden (A. D.) & Jeppson (L. R.). **Test comparing the Effectiveness of DDT and Rotenone against Pear Thrips Larvae,** p. 18. A DDT spray (5 pints SH20 per 100 gals. water) applied to pear trees on 2nd May was as effective against nymphs of the pear thrips [*Taeniothrips inconsequens*, Uzel] as a spray of 1·1 lb. of a preparation containing 4 per cent. rotenone, 8 per cent. other cubé resins and 17 per cent. petroleum oils with 4 oz. sodium oleyl sulphate or one containing 8 oz. of a rotenone spray material with spreader and 4 U.S. pints tank mix oil, both per 100 U.S. gals., and reduced the average number of nymphs per cluster from 42 to 3 after two and six days. It caused spotting of the leaves.

Borden (A. D.) & Jeppson (L. R.). **Tests with DDT on Tussock Moth attacking Pear,** p. 18. A DDT spray (5 pints SH20 per 100 gals. water) gave good control of larvae of *Hemerocampa vetusta*, Boisd., on pear when applied on 1st May but caused spotting of the foliage.

Lange jr. (W. H.). **Experiments with DDT in Oils applied as Vapo-sprays for controlling Pea Insects,** pp. 18–22. In these tests, DDT was used in a vapo-spray oil (70 per cent. mineral seal oil with a viscosity of 45–50 and 30 per cent. kerosene) at concentrations of 0·3, 0·6, 1·2 and 2·4 per cent. by weight and at 1·2 per cent. with rotenone and cresylic acid or Cardolite [*cf.* **31** 491]. It was also applied at 1·2 per cent. in a lighter oil. Two applications were made by means of a vapo-spray machine during August and September at a rate of 5 U.S. gals. per acre to peas in experimental plots sown on 20th July. The reduction in infestation by *Macrosiphum onobrychis*, Boy., as compared with untreated plants was directly proportional to the DDT content of the sprays, and of the order of 80 per cent. for the more effective ones ; combinations of 1·2 per cent. DDT with 0·05 or 0·25 per cent. rotenone were superior to 1·2 per cent. DDT alone and about as effective as 2·4 per cent. DDT alone. There were significant decreases in the numbers of thrips, chiefly *Frankliniella helianthi*, Moult., present one and seven days after the first application in plots sprayed with DDT at 1·2 per cent. or more. The sprays had no apparent effect on adults of *Agromyza* (*Liriomyza*) *flaveola*, Fall., but the results were obscured by migration from a neighbouring sugar-beet field ; fewer mines were found in the lower leaves in plots treated with the higher concentrations of DDT and with DDT and rotenone. Lepidopterous larvae were destroyed by all concentrations.

Jeppson (L. R.) & Borden (A. D.). **Field Tests with DDT and Sulfur against the Potato Leafhopper on Potatoes grown for Seed,** p. 22. Two DDT dusts (A3 and a mixture of 5 lb. AK20 and 95 lb. dusting sulphur) applied on 21st August to potatoes grown for seed greatly reduced the number of nymphs of *Empoasca abrupta*, DeL., and maintained them at a very low level for at least 19 days. Sulphur alone was much less effective.

Stafford (E. M.). **Tests with DDT for the Control of certain Scale Insects,** pp. 22–24. The toxicity of DDT spray residues to the crawlers of three species of Coccids was investigated. The results of laboratory and field experiments with *Parlatoria oleae*, Colv., on olive, Italian jasmine [*Jasminum humile*] and privet [*Ligustrum*] were unsatisfactory, since the degree of control was always determined by the viscosity and concentration of the oil in the sprays, regardless of the concentration of DDT, and even fresh deposits of the latter did not prevent many crawlers from settling and moulting successfully. Field tests with DDT against *Lepidosaphes ficifoliae*, Berl., on fig were also unsuccessful, but promising results were obtained against *Saissetia oleae*, Bern., on olive. A spray of 1¼ U.S. gals. mineral seal oil containing 6 per cent. DDT (GNB-A) and one of 2 lb. of a talc powder containing 20 per cent. DDT (GNB-A) and 0·75 per cent. heavy summer oil, both with 4 oz. blood albumin in 100 U.S. gals. water were applied on 26th May, before hatching began, and resulted in 53·1 and 52·6 per cent. mortality of young scales, respectively, by 31st July, as compared with 36·8 per cent. for no treatment. A spray of 2 gals. light medium soluble oil containing 5 per cent. DDT (GNB-A) in 100 gals. water applied on 27th July after some of the eggs had hatched, was about as effective against the adult females as one of 1 U.S. gal. heavy medium oil and ½ lb. derris root (5 per cent. rotenone content) per 100 U.S. gals. water after an interval of three weeks, but the percentages of leaves bearing living young scales were 1 and 10 respectively.

Gardner (M. W.), Michelbacher (A. E.) & Smith (R. F.). **Spraying with DDT in a Greenhouse to control Thrips, the Vectors of Spotted Wilt in Tomatoes,** pp. 24–27, 1 fig. In experiments on the control of the thrips that transmit the virus of spotted wilt [*Lethum australiense* var. *typicum* of Holmes] to tomatos in greenhouses, four applications of a spray containing 1 lb. DDT (5 lb. AK20 in the first three and 1 lb. GNB-A in the fourth) with 6 oz. blood albumin in 100 U.S. gals. water, made at intervals of about a fortnight in August and September, effectively controlled the thrips and the disease, but injured the plants rather severely. The damage comprised yellowing of the leaves between the main veins and round the margins, followed by the death of the lower leaves up to a height of 2½ ft. There was also evidence of retarded growth and a marked reduction in yield. Frequent fumigation with nicotine was less effective against the thrips, but did not injure the plants.

Lange jr. (W. H.). **Laboratory Tests with DDT on Truck-crop Insects,** pp. 27–28. The effect of vaporised sprays containing 0·3–3·6 per cent. DDT (by weight) in a mixture of 30 per cent. kerosene and 70 per cent. mineral seal oil and of dusts containing 1 or 3 per cent. DDT in pyrophyllite on insects associated with vegetable crops was tested in the laboratory. The insects were mostly collected from lucerne, and the sprays were applied at rates equivalent to 5–6 U.S. gals. per acre and the dusts at rates equivalent to 35–40 lb. per acre. Adults of *Diabrotica undecimpunctata*, Mannh., sprayed with DDT were affected more noticeably than those placed on broccoli plants treated with it, but the period required for complete mortality was about the same. All the sprays and dusts gave complete mortality, and the beetles ceased feeding almost immediately though they did not die for several days. In tests of the lasting effect of the spray residues, those from 2·4 and 3·6 per cent. sprays killed all beetles placed on plants treated several weeks before, whereas those from the 1·2 per cent. spray did not. Adults of *Lygus hesperus*, Knight, were killed by 1·2–3·6 per cent. sprays applied directly to them or to broccoli plants

on which they were subsequently placed, and there was little difference in the periods required for complete mortality. The weaker sprays and the dusts were not tested against them. They were affected as soon as they came in contact with the DDT, and when lucerne plants sprayed with 3·6 per cent. DDT were introduced 11 days later into a cage containing ten bugs, all the latter were dead in four days. The 1·2 and 2·4 per cent. sprays and the dusts were tested against larvae of *Listroderes obliquus*, Klug, and all gave complete mortality, whether applied directly to them or to sections of carrot on which they were subsequently placed. The larvae at first fed readily on the treated carrot and then remained immobile for several days before dying. Larvae of *Gnorimoschema operculella*, Zell., reacted violently to the 0·6 and 1·2 per cent. sprays and the 3 per cent. dust applied directly to them, but showed little immediate reaction when placed on treated slices of potato tuber, though all were dead in a few days ; the sprays were somewhat more rapid in action than the dust. Adults that were sprayed with DDT (0·6 or 1·2 per cent.) were immobilised immediately and died within 24 hours.

Michelbacher (A. E.), Swanson (C. H.) & Smith (G. L.). **Controlling Codling Moth** [*Cydia pomonella*, L.] **on Walnuts with DDT,** p. 29, and **Effect of DDT on the Walnut Aphid** [*Chromaphis juglandicola*, Kalt.], p. 30. The information in these two papers has already been noticed [**34** 309].

Broyer (T. C.). **Studies on the possible Effects of DDT on the Growth of Rice and Barley,** p. 31. In view of the use of DDT for mosquito control in irrigated areas, its possible secondary effects on crop production were investigated in the laboratory. The germination of rice seed kept in aerated suspensions of DDT in water at concentrations of 0·1–100 parts per million was not materially affected ; the viability of the seed was not markedly impaired by concentrations soluble in aqueous media, or by excess of the insecticide in suspensions in intimate contact with the germinating organism. The growth of various common soil micro-organisms was not significantly affected when they were kept in appropriate media in which were incorporated water suspensions of DDT at concentrations of 10 and 100 p.p.m. Rice and barley sown in tanks in soil that had been treated with an emulsion as recommended for the annual DDT irrigation flooding of rice lands to control mosquito larvae (5 per cent. DDT and 0·5 per cent. emulsifier in no. 2 diesel fuel oil applied at the rate of 1 part in 20 million parts water) germinated normally, and plant growth, including grain production and maturation, was satisfactory. Similar results were obtained with rice when the growing plants were flooded. It is concluded that the recommended treatment for mosquito control is not detrimental to the soil, at least for a few applications.

Hoskins (W. M.). **Analyses for Deposits and Residues of DDT in 1944,** pp. 31–33. In some of the experiments described in the preceding sections, quantitative analyses were made of the residues of DDT left on the treated foliage and fruits. The method, which is based on the liberation of hydrogen chloride from the DDT when it is warmed with alcoholic alkali [*cf.* **35** 110], is described, and the results obtained with lucerne, pears, peas, walnuts, olive foliage and fruits and immature and mature tomato fruits are given.

The report also includes **Use against Household Insects and Insects of Medical Importance** (pp. 3–4) by S. B. Freeborn, and **Control of Flies in a Dairy Barn with DDT** (pp. 8–9), by A. E. Michelbacher, R. F. Smith and G. L. Smith. These papers are noticed elsewhere [B **35** 57], but it is stated in the first that a spray of kerosene containing 5 per cent. DDT is extremely toxic to the Argentine ant [*Iridomyrmex humilis*, Mayr] and has controlled it when applied round the casings of doors and windows of masonry buildings. It cannot be effectively used in frame houses, however, owing to the many entrances available to the ants.

SHIRCK (F. H.). **Crop Rotations and cultural Practices as related to Wireworm Control in Idaho.**—*J. econ, Ent.* **38** no. 6 pp. 627–633, 3 figs., 5 refs. Menasha, Wis., 1945.

This is a final report on field-plot studies carried out in south-western Idaho in 1931–42 to evaluate various crop rotations and cultural practices with reference to the control of wireworms, chiefly *Limonius californicus*, Mannh., under conditions of irrigated farming. A preliminary report covering the years 1931–34 has already been noticed [*R.A.E.*, A **25** 248].

Experiments to compare the effect of various crop rotations showed that under normal conditions, changes in wireworm populations were gradual from year to year, but excessive increases occurred in fields of red clover. The highest infestations were in the crops immediately following red clover, but it is considered that the greatest increase in infestation took place while the latter was still present. In view of this, sweet clover [*Melilotus*] or lucerne was substituted for red clover in the rotations. There appeared to be a tendency for populations to increase immediately after sweet clover but this was less marked than after red clover. The increases in population in lucerne [*cf.* **25** 249] were unexpected, as general observations in the area indicated that there is usually a decline in this crop [*cf.* also **33** 23 ; **34** 74]. Since it was found that relatively few adults matured in lucerne each year, it was concluded that gravid females flying into the plots must have been mainly responsible. The growing of vegetable crops year after year eventually increased wireworm infestation and was undesirable for maintaining soil fertility. Red clover and sweet clover were found to be unsafe for inclusion in vegetable-crop rotations because of the increase in wireworm populations that follow their use.

The results indicated that a rotation of lucerne for four years, early potatoes in the fifth year, maize or sugar-beet in the sixth, and wheat in the seventh would prevent the development of excessively high wireworm populations ; such a rotation would maintain soil fertility and permit ploughing early in August for the control of pupae after harvesting early potatoes and wheat. Population trends under this rotation were therefore studied in 1937–42. The numbers of wireworms tended to increase after maize and to decrease slightly after sugar-beet. On the whole, there were only slight fluctuations, and no definite population trends in the last three years of the rotation. Significant downward trends were noted in lucerne in which the initial population was high, and this was greater on plots that were not irrigated than on those that received normal irrigation, although the difference was not significant.

A general survey of 52 fields showed that the average wireworm population increased in the year after lucerne and remained significantly higher for the next two years ; the numbers of adults continued to increase in the second year, probably because the availability of more succulent foods caused an acceleration in the development of the larvae and the loosened soil condition, due to the cultivation of annual crops, favoured the formation of pupal cells. The increase was significant for potatoes and maize, but not for sugar-beet.

It is concluded that a relatively long crop rotation, in which the land is in lucerne at least half the time, appears to offer the best chance of cultural control.

MUNSON (S. C.) & YEAGER (J. F.). **Concentration-Survival Time Relationship for Roaches injected with Arsenicals.**—*J. econ. Ent.* **38** no. 6 pp. 634–642, 3 figs., 4 refs. Menasha, Wis., 1945.

The following is based on the authors' summary. When sodium monohydrogen orthoarsenate and sodium metarsenite were injected into large nymphs of *Periplaneta americana*, L., and the concentration was plotted against survival time, hyperbolic curves characterised by a region of inflection and by a critical zone were obtained [*cf. R.A.E.*, A **33** 64]. Lead arsenate gave a curve that exhibited no inflection but did have a critical zone. Sodium arsenate and

sodium metarsenite were equally toxic to the cockroaches, except in the higher concentrations, where the arsenite was the more toxic, and lead arsenate was less toxic than either. These results are explained by a dissociation hypothesis [*loc. cit.*], according to which the arsenical ions formed by the sodium metarsenite and the sodium arsenate (and probably by the lead arsenate) are equally toxic, and the differences in toxicity between the salts are due largely, if not entirely, to differences in their degree of dissociation. Survival times that agree well with the observed times were calculated by the use of equations based on the dissociation hypothesis.

Methods are suggested for estimating the volume of blood in an insect and for comparing toxicity symptoms caused by different poisons, and suggestions are made as to why such simple expressions as ct=constant, where c is molar concentration and t survival time, may happen to apply to biophysical systems under certain conditions of simplification. Evidence is presented that the larva of *Tenebrio molitor*, L., is more resistant than *P. americana* to poisoning by sodium metarsenite applied as in these experiments.

Lange jr. (W. H.). **Ethylene Dibromide and Dichloropropane-dichloropropene Mixture for Wireworm Control.**—*J. econ. Ent.* **38** no. 6 pp. 643–645, 4 refs. Menasha, Wis., 1945.

Experiments were carried out in California in 1944–45 to compare the effectiveness against wireworms, chiefly *Limonius californicus*, Mannh., of undiluted D-D mixture (a mixture of saturated and unsaturated chlorinated compounds, chiefly 1,2-dichlorpropane and 1,3-dichlorpropene) [*cf. R.A.E.*, A **33** 55] and a solution of 10 or 15 per cent. ethylene dibromide in a naphtha 200 base. The fumigants were forced into the ground under low pressure from commercial trailer apparatus with a series of soil drills 12–15 in. apart and drilled as a continuous stream at a depth of 6–8 in. A drag or roller was used to seal the surface of the ground in most instances. In a preliminary experiment in 1944, the application in December of 40 U.S. gals. D-D mixture with 35 lb. anhydrous ammonia, 42 U.S. gals. of the 15 per cent. dibromide solution with 30 lb. anhydrous ammonia and 42 or 50 U.S. gals. of the solution alone per acre reduced the percentage damage to lettuces planted ten days later from 5·57 to 0·14, 0·12, 0·36 and 0·4, respectively, and increased the yield (in 80-lb. crates per acre) from 173 to 249, 298, 189, and 214. In 1945, soil sampling in June to a depth of 10 ins. showed complete kill of wireworms for applications in May of 30 and 40 U.S. gals. ethylene dibromide (10 per cent.) and 60 U.S. gals. D-D mixture per acre and 75 and 92 per cent. kill for 20 and 40 U.S. gals. of the mixture per acre. The same materials and quantities reduced the percentage damage to lima-bean plants sown two weeks after application in May from 11·9 to 1·3, 0·5, 1·3, 2·8 and 3·2, respectively. Applications of 40 U.S. gals. D-D mixture or 5 per cent ethylene dibromide per acre to a heavily infested field in June increased the yield of lettuce from 58·2 to 408·3 and 289·1 crates per acre.

It is concluded that the use of 40 U.S. gals. D-D mixture per acre affords the most economical control and the highest yield, although not affecting a complete kill of wireworms. When this mixture was applied in late autumn, before lettuce was grown, the addition of 35 lb. ammonia per acre as a fertiliser resulted in the greatest yield, possibly because the fumigant suppresses nitrification for a limited period and the lettuce plants are able to use ammoniacal nitrogen during this time.

Balock (J. W.) & Starr (D. F.). **Mortality of the Mexican Fruitfly in Mangoes treated by the Vapor-heat Process.**—*J. econ. Ent.* **38** no. 6 pp. 646 651, 3 figs., 6 refs. Menasha, Wis., 1945.

Investigations carried out in 1943 on the vapour-heat sterilisation of mangos infested in Mexico by *Anastrepha ludens*, Lw. [*cf. R.A.E.*, A **33** 396] are

described, and the results are analysed statistically. The data cover 23 experiments, in which 25,300 mangos with an estimated population of 205,343 larvae were used. It was calculated that, in addition to the eight-hour period in which the temperature of the fruit is raised gradually from room temperature to 110°F., the exposures required for a security value of 99·9968 per cent. mortality [*cf.* **28** 491] are 5·7 and 3·9 hours, based on the numbers of larvae that pupate and that give rise to adults, respectively. The cabinet used is described ; no significant differences due to position in it were found.

WADLEY (F. M.). **Incomplete Block experimental Designs in Insect Population Problems.**—*J. econ. Ent.* **38** no. 6 pp. 651–654, 8 refs. Menasha, Wis., 1945.

In field-plot experiments involving a large number of treatments, in which such designs as ordinary randomised blocks may lose much of their efficiency in controlling error because of increase of block size, smaller blocks with incomplete sets of treatments in each may be used. They are adapted to a situation in which a large number of experimental treatments (16 or more) are to be compared and where field variation is important. Differences between the small blocks are evaluated and allowed for in analysis, but to make this possible, certain requirements as to number of experimental treatments and replications, as well as field arrangement, must be met. The applications of these designs to entomological work are discussed, and the results are given of their use in three practical experiments. It is concluded from these preliminary tests that insect populations and their activities tend to vary locally and that there is a chance of some improvement in precision from the use of incomplete block designs. The improvement so far obtained has been moderate, and a gain of efficiency equivalent to that obtainable from the addition of another replication in ordinary tests is suggested as likely.

WENE (G.) & RAWLINS (W. A.). **Compatibility of Cryolite and Copper Fungicides.** —*J. econ. Ent.* **38** no. 6 pp. 655–657, 2 refs. Menasha, Wis., 1945.

The results are given of laboratory and field experiments in New York State on the compatibility of cryolite with Bordeaux mixture and proprietary fixed copper fungicides. In the laboratory tests, micronised natural cryolite (at least 90 per cent. sodium fluoaluminate) at 6 lb. per 100 U.S. gals., alone and mixed in water suspension with the fungicides within 30 minutes of use, was sprayed on to the underside of bean leaves to give average deposits of 0·3 mg. cryolite per sq. cm. These were allowed to dry thoroughly and the leaves were supplied daily to larvae of *Epilachna varivestis*, Muls., in the third and fourth instars for 1, 3 or 5 days, after which the larvae were transferred to unsprayed leaves. The pH readings for fixed copper sprays were almost neutral, whereas Bordeaux mixture was very basic in reaction. The addition of cryolite slightly reduced the pH values, but not enough to produce marked changes in the mixtures. Cryolite acted slowly and required three and five days to produce more than 50 per cent. mortality of larvae in the third and fourth instars, respectively. Fixed copper compounds did not adversely affect its toxicity, whereas Bordeaux mixtures delayed and reduced but did not destroy it. Considerably more feeding took place on leaves sprayed with cryolite and Bordeaux mixture than on any others.

A single field experiment, in which mixtures of cryolite (6 lb. per 100 U.S. gals.) with Bordeaux mixture (8 : 4 : 100) or two fixed coppers were applied to potatoes infested by *Leptinotarsa decemlineata*, Say, showed that the larvae were more susceptible to cryolite than those of *E. varivestis*. The percentages of larvae killed were 59 and 60 in one day and 74 and 81 in five, by the sprays

containing fixed coppers, and 21 in one day and 72 in five by that containing Bordeaux mixture, indicating that the latter retarded, but did not materially reduce, the toxicity of the cryolite.

Muma (M. H.), Langford (G. S.) & Cory (E. N.). **Modification of the Geraniol and Eugenol Content of Japanese Beetle Bait.**—*J. econ. Ent.* **38** no. 6 pp. 658–660, 4 refs. Menasha, Wis., 1945.

Owing to the difficulty of obtaining geraniol and eugenol for use in baits for the Japanese beetle [*Popillia japonica*, Newm.], modifications in the bait that would permit economy in these materials have been tested in Maryland since 1942 [*cf. R.A.E.*, A **31** 488; **33** 55]. The efficiency values of the mixtures are shown by figures expressing the numbers of beetles attracted by them as percentages of the numbers attracted by the standard bait of 9 parts geraniol and 1 part eugenol [**31** 488]. It was found that a mixture of equal parts of geraniol and eugenol made an effective bait, and it had a value of 140·2 when diluted with 30 per cent. of a mixture of equal quantities of refined kerosene (Deobase oil) and light white mineral oil (Saybolt viscosity 125–135). When the standard bait was diluted with an equal amount of the oil mixture, its value was 97·5.

In tests with other attractants, anethol [*cf.* **32** 373], citral, and mixtures of equal parts of caproic acid, ethyl caproate or phenyl ethyl butyrate and light white mineral oil, which was necessary to reduce their rate of evaporation [*cf.* **34** 341], were mixed with geraniol, eugenol or the standard bait in the ratio of 9 : 1. Caproic acid was the most effective; mixtures of it with geraniol, the standard bait, and eugenol had values of 106·5, 104·3 and 80·5, respectively. The values for mixtures of phenyl ethyl butyrate and ethyl caproate with the standard bait were 95·7 and 80·3, respectively; mixtures with geraniol or eugenol were less effective, but the mixtures with eugenol gave inconsistent results, appearing to be most attractive when used in the vicinity of favoured food-plants. Anethol, with a value of 83·2 with eugenol, showed promise as a substitute for geraniol, and citral, an optical isomer of geraniol, was rather less effective.

Kearns (C. W.), Ingle (L.) & Metcalf (R. L.). **A new chlorinated Hydrocarbon Insecticide.**—*J. econ. Ent.* **38** no. 6 pp. 661–668, 5 refs. Menasha, Wis., 1945.

An account is given of preliminary experiments on the insecticidal properties of a chlorinated hydrocarbon with the empirical formula $C_{10}H_6Cl_8$, referred to as 1068. It is possibly a mixture of isomers and can readily be obtained as a viscous, colourless, odourless liquid that is easily soluble in all proportions in most organic solvents, including aromatic, aliphatic and chlorinated hydrocarbons, ketones, ethers, esters and alcohols, but is insoluble in water. Its volatility is low, though considerably higher than that of DDT. It has shown no tendency to irritate the skin or mucous membranes. In the presence of weak alkali, 1068 readily loses hydrogen chloride and forms a product that is apparently not toxic to insects, and it should therefore not be used with materials having an alkaline reaction. A solution of any desired strength can be made in almost any type of suitable oil carrier, the most convenient being kerosene, deodorised kerosene (Deobase), fuel oil, xylene and methylated naphthalenes. The addition of small amounts of oil-soluble emulsifiers to such oil solutions makes concentrates from which emulsions can be made by the addition of any desired amount of water. The compound can also be emulsified directly in water by the addition of a soluble emulsifier, but in this case higher proportions of emulsifier must be used. Dusts containing 5 per cent. 1068 or less can be prepared by impregnating talc, clays or other non-alkaline carriers with it.

In laboratory experiments against insects [*cf.* also *R.A.E.*, B **35** 50], 1068 was compared with DDT and in some cases with the γ isomer of benzene

hexachloride [*cf.* A **33** 256]. In tests of the three products as stomach poisons for *Melanoplus differentialis*, Thos., xylene concentrates were emulsified with a solution of molasses in water to give 0·5, 1 and 2 per cent. active ingredient. Measured drops of these emulsions were placed on the mouthparts of grasshoppers, which were watched until the drops were completely ingested and then transferred to cages with food and water. From mortality counts made after 24 hours it was estimated that the median lethal dose per gm. body weight was between 5 and 10 mmg. for the γ isomer, between 12·5 and 25 for 1068 and more than 50 for DDT. The average weight of the grasshoppers used was 2 gm.

A comparison of the toxicities of 1068 and DDT as contact insecticides was made by applying measured dosages of the two compounds in an emulsion to the thoracic tergites of adults of *Periplaneta americana*, L. Dosage-mortality curves plotted from the data obtained indicated that the amounts in mmg. per gm. body weight required to give 95 and (in brackets) 50 per cent. mortality in 120 hours are 25(14) for 1068 and 70(38) for DDT.

Preliminary tests having shown that both 1068 and DDT could readily be dispersed in a solution of acetone and water (3 : 1), and that the solution without the active compounds could be applied to Aphids in sufficient quantity to wet them thoroughly without causing any mortality, tests were carried out in which apterous females of the spiraea Aphid, *Aphis spiraecola*, Patch, were sprayed on infested twigs, and apterous females of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) were sprayed on cheesecloth and then transferred to previously sprayed pea leaves. The percentage mortalities of *A. spiraecola* in 24 hours were 100, 95, 95 and 86 for 1068 at 1 : 800, 1 : 2,000, 1 : 6,000 and 1 : 8,000, respectively, and 91, 76, 47 and 49 for DDT at the same concentrations; 1068 killed 100 per cent. of *M. onobrychis* in 48 hours at 1 : 250 and 1 : 500 and 90 per cent. or more at 1 : 1,000–1 : 4,000, whereas DDT killed less than 90 per cent. at all these strengths. The mortality in 72 hours of third- and fourth-instar larvae of *Leptinotarsa decemlineata*, Say, placed on potato leaves that had been sprayed with the same solutions and allowed to dry, was 100, 90, 80 and 60 per cent. for 1068 at concentrations of 1 : 500, 1 : 1,000, 1 : 2,000 and 1 : 4,000; and 80, 60, 20 and 30 for DDT at the same concentrations. The quantity of leaves consumed was much smaller when they were sprayed with 1068 than with DDT. There was no mortality on leaves sprayed with acetone solution only.

When adults of the squash bug (*Anasa tristis*, Deg.) were kept on the upper surface of leaves dusted with mixtures of 1068 or DDT in talc, 1068 gave complete mortality in 72 hours at concentrations of 5 and 4 per cent. and 88 per cent. at 3 and 2 per cent., whereas the DDT gave only 26 per cent. mortality at 5 per cent. and 13 per cent. at the lower concentrations. When the bugs were rolled in dust, 2 per cent. 1068 and DDT caused 100 and 25 per cent. mortality, respectively, after 48 hours, with no increase for DDT after another 24 hours. At a concentration of 1 : 1,500 in a spray prepared from a xylene concentrate, 1068 caused 75 per cent. mortality of adults in 72 hours when the bugs were placed on sprayed leaves and 100 per cent. in 48 hours when both bugs and leaves were sprayed, whereas DDT caused no mortality in the first case and only 25 per cent. in 72 hours in the second. In no instance did treatment with talc alone or with the xylene emulsion alone cause any mortality. Most of these tests indicated that 1068, like DDT, takes effect slowly.

LATTA (R.). **Preliminary Investigations on Heat-generated Aerosols for the Control of agricultural Pests.**—*J. econ. Ent.* **38** no. 6 pp. 668–670, 3 refs. Menasha, Wis., 1945.

In the course of attempts in the United States to develop appliances for the production by means of heat of aerosols that could be economically used against

agricultural insect pests, tests were made with an oil-fog generator of the type used in the U.S. Army, DDT being dissolved in the oil used to produce the smoke [*cf. R.A.E.*, A **34** 262]. Investigations in 1944 showed that particles larger than those used in screening smokes were more effective against insects, and the apparatus was modified to give particles approximately 2–3 microns in diameter. In a test against *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on lucerne, the aerosol gave control only for 25–50 ft. from the generator, which was not promising, but in a test in a forest area on Cape Cod, larvae of *Lymantria* (*Porthetria*) *dispar*, L., were affected for distances of 1,400 ft. from the point of generation, and good control was obtained on areas of up to half an acre when the aerosol was produced from a single point and allowed to drift downwind. A different apparatus was subsequently designed that can be adjusted to produce particles of almost any size and causes no destruction of DDT by heat, the maximum temperature used being only half as high. It gave very encouraging results in further tests against *L. dispar*.

These aerosols are at present generated from apparatus mounted on lorries that are driven slowly across the direction of the wind, and notes are given on their advantages and disadvantages and on the weather conditions that are favourable for their use on open ground and low-growing crops and in forests. Up to 16 per cent. or more DDT can be used in the original mixture, and oils widely differing in solvent action can be employed, with a mutual solvent if desired.

Wolfenbarger (D. O.) & Heuberger (J. W.). **Disodium Ethylene Bisdithiocarbamate for Control of Mexican Bean Beetle.**—*J. econ. Ent.* **38** no. 6 pp. 675–678, 3 figs., 6 refs. Menasha, Wis., 1945.

The experiments described were carried out in Delaware to verify a recent report that soil treatment with disodium ethylene bisdithiocarbamate (Dithane) controls the Mexican bean beetle [*Epilachna varivestis*, Muls.] on beans, indicating that the plants take up the chemical through the roots and distribute it in the stems and leaves. Dosages of 25, 100 and 400 lb. Dithane per acre were applied for the protection of bush dwarf lima and string beans, planted 1½ inches deep on 3rd July. The powder was distributed in bands three inches wide in furrows three inches deep six days before sowing, or in furrows two inches deep and three inches from the plant rows two weeks after sowing, after which the soil was levelled, or applied to the rows in a water solution three weeks after sowing. These soil treatments were compared with sprays in which Dithane was applied at the rate of 4 lb. in 200 U.S. gals. water per acre and a preparation of basic copper arsenate and nicotine sulphate, containing 23 per cent. arsenate and 2 per cent. nicotine alkaloid, at 8 lb. in 200 U.S. gals. water per acre, 26, 32 and 41 days after sowing.

Dithane applied by the first method delayed the appearance of the plants and reduced the stands of both beans, and all the soil treatments resulted in stunted plants and marginal yellowing of the foliage. All such symptoms were more pronounced on plants treated with the heavier dosages. Infestation by *E. varivestis* was light until the middle of the season, when it became heavy. The average total of larvae, pupae and adults per 5 ft. of row and (in brackets) the average yield in oz. per 5½ yards of row for the three soil dosages were 30·5 (187·5), 8 (174) and 2·5 (96) in the first treatment, 42·8, (247·3), 11·8 (274·5) and 2·5 (215·5) in the second and 72·5 (226·5), 19 (201·5) and 3·8 (171·5) in the third on lima beans and 140·8 (124), 12·5 (112·3) and 0·5 (85) in the first, 197·3 (106·3), 32·5 (88·5) and 3·3 (65·3) in the second and 185·5 (98·5), 38·3 (92) and 2 (77·5) in the third on string beans. The corresponding figures for the Dithane sprays, the other sprays and no treatment were 16·8 (202·5), 9 (256·5) and 68·8 (217) on lima beans and 32·8 (124·5), 7·5 (128·3) and 199·3 (106·8) on string beans. The minimum differences for significance were 22·6 (45·3) on lima beans and 56·4 (47·7) on string beans.

It is concluded that although doses of 100 and 400 lb. Dithane per acre effectively reduced beetle infestation, further investigations are necessary, as they also reduced the yields. Small numbers of *Empoasca fabae*, Harr., and *Strymon melinus*, Hb., were found on the plants, and there was no indication that they were controlled by any of the treatments. No change in flavour of the beans that could be associated with Dithane was noted.

THOMAS (W. A.). **Experiments with Insecticides to control the Strawberry Weevil in North Carolina and Maryland.**—*J. econ. Ent.* **38** no. 6 pp. 678–682, 5 refs. Menasha, Wis., 1945.

The results are summarised of experiments carried out between 1920 and 1938 in North Carolina and in 1939 on the Eastern Shore of Maryland on the control of *Anthonomus signatus*, Say, on strawberry. Two or three applications of sprays or dusts were made as soon as the weather permitted after the weevils had begun to cut the fruiting buds, frequent examinations were made of the number of buds produced, the number cut by the weevil and, in the later years, the number that developed into berries, and the efficiency of the insecticides was judged by the percentage reduction in cut buds and the percentage increase in the weight of marketable berries, as compared with untreated plots. In 1920 and 1922, dusts of lead arsenate, alone or with different proportions of sulphur, gave good reductions in numbers of cut buds, but not always satisfactory increases in yield ; lead arsenate and sulphur (1 : 5) gave the most promising results. A dust containing 2 per cent. nicotine sulphate and lime was unsatisfactory. In 1925–32, comparison of calcium arsenate and lead arsenate in various dust mixtures showed that the former gave the more effective control, with a maximum of 84 per cent. in 1931, and that sulphur was a better diluent for it than a mixture of dehydrated copper sulphate and hydrated lime. Calcium fluosilicate dust and a pyrethrum spray of unknown pyrethrin content were relatively ineffective, but dusts of potassium hexafluoaluminate in sulphur (17 : 83) and a pyrethrum powder of unknown pyrethrin content gave promising results. In 1931, potassium hexafluoaluminate, calcium arsenate or lead arsenate in sulphur (1 : 5) and pyrethrum powder gave 56–68 per cent. control on dewberries when applied twice at 20–32 lb. per acre. In 1935–37, 17 per cent. calcium arsenate in sulphur gave 48–70 per cent. control on strawberries and was more effective than derris and clay (0·5 and 1 per cent. rotenone) or pyrethrum and clay (0·05–0·25 per cent. pyrethrin I). All the materials tested in 1938, including calcium arsenate and cryolite, gave very unsatisfactory control. In 1939, 17 per cent. calcium arsenate in sulphur gave 44 per cent. control, cryolite undiluted (85 per cent. sodium fluoaluminate) and with sulphur (42 per cent. sodium fluoaluminate) gave 69 and 64 per cent., and nicotine bentonite (3 per cent. fixed nicotine) was ineffective. In no case did treatment result in significant increases in yield, and the probable reason for this was the fact that the strawberry plants produced many more buds than could develop into marketable fruit. It is considered that control measures against the weevil would not be justified in fields in which less than 25 per cent. of the buds were cut, but there is no way of determining how many will be cut in time for insecticides to be applied.

WEIGEL (C. A.) & GERTLER (S. I.). **The synergistic Action of *N,N*-Diethylpiperonylamide with Pyrethrum Marc in Control of the Mexican Bean Beetle.**—*J. econ. Ent.* **38** no. 6 pp. 683–686, 4 refs. Menasha, Wis., 1945.

The authors describe tests carried out in Maryland in 1944 in which compounds that were thought to possess some synergistic or other desirable properties were tested with pyrethrum marc in order to obtain information on the possibility of using the latter as an insecticide. An even coating of dusts of pyrethrum

marc, pyrophyllite and the compound to be tested (60 : 38 : 2) was applied either to third-instar larvae of *Epilachna varivestis*, Muls., on bean plants or to plants that were subsequently artificially infested with the larvae, and mortality was determined after 96 hours. In greenhouse tests in February and March pyrethrum marc alone and with 1-chlor-2(2-(2,3,4,6-tetrachlorphenoxy)ethoxy)-ethane caused the larvae to drop from the plants, but many eventually recovered and resumed normal feeding ; pyrethrum marc with N,N-diethylpiperonylamide also caused dusted larvae to drop, but though a few recovered temporarily and fed a little, all were eventually killed. It also killed 57 per cent. of larvae on dusted foliage. The plants were caged in these tests, and the fact that mortalities were lower, though in the same relative order, when the larvae were dusted on plants that were not caged indicated that the effective mixture may have a slight fumigating effect. All three treatments were ineffective against larvae that were nearly fully grown. In a test to determine whether the compound was itself toxic, dusts of N,N-diethylpiperonylamide and pyrophyllite (2 : 98), pyrethrum marc and pyrophyllite (60 : 40) and a mixture of all three materials (2 : 60 : 38) caused 15, 17 and 77 per cent. mortality of dusted larvae and 13, 8 and 52 per cent. of larvae on dusted plants, as compared with 1·7 for no treatment.

In similar tests with other compounds, in which the dusts were applied to the larvae on the plants, N-amylbenzamide increased the mortality given by pyrethrum marc from 17 to 50 per cent., but N-butylbenzamide, ethylmethyl ketone semicarbazone, 4-methylcyclohexanone semicarbazone, N-isobutyl-undecyleneamide and ethylene glycol ether of pinene had little or no value, and 3,4-methylenedioxybenzyl-n-propyl ether and α-(n-propyl)piperidine, which increased mortality to 90 and 100 per cent., severely injured the plants.

In outdoor tests, plants dusted on 27th July and 4th, 14th and 25th August with pyrethrum marc, pyrophyllite and N,N-diethylpiperonylamide (60 : 38 : 2) and with a cubé dust containing 0·5 per cent. rotenone had 67 and 2 larvae per 10 trifoliate leaves just before the third application, and 8 and 0 one day after the last application, as compared with 66 and 109 for no treatment. Inspection of plants dusted with the pyrethrum-marc mixture on 15th September showed that most of the adults and larvae were on the ground and apparently moribund within two hours. Some had returned to the plants by the next day and others had been carried away by ants ; of 71 collected the day after treatment and transferred to untreated plants in the laboratory, 62 per cent. died in a week.

It is concluded that N,N-diethylpiperonylamide is a synergist for pyrethrum marc when used against *E. varivestis*. It appears to act as a paralytic agent rather than a stomach poison, and since the affected insects drop to the ground, any factor such as extreme heat or direct sunlight would tend to increase the kill.

Ebeling (W.). **DDT Penetration prevented by adding Aluminum Stearate to DDT-Kerosene Solutions.**—*J. econ. Ent.* **38** no. 6 pp. 689–691, 1 fig., 2 refs. Menasha, Wis., 1945.

When 0·1 ml. of a solution of 4 per cent. by weight of DDT in kerosene was applied with a camel's-hair brush to half the lower surface of an orange leaf, the solvent was found to penetrate into the leaf completely in less than ten minutes, carrying most of the DDT with it, whereas the same quantity of solution with the addition of 1 per cent. aluminium stearate, applied to the other half, remained on the surface for some hours, the solvent slowly leaving by evaporation rather than by penetration. Microphotographs showed a much heavier deposit of DDT crystals on the surface of the second half. As the addition of DDT to a solution of kerosene and aluminium stearate reduces the gel-forming ability of the latter and results in a less viscous solution, 2 per cent.

aluminium stearate was added in the following tests, although solutions containing 1 per cent. seemed to penetrate the lower surfaces of *Citrus* leaves no more rapidly. In these tests, practically equal quantities per unit area of the solution with and without 2 per cent. aluminium stearate were applied to the lower surfaces of batches of orange leaves and to sections of lemon branches covered with grey rough bark, which absorbs even the films of oil deposited by the regular oil sprays very rapidly, and the treated leaves and branches were kept at room temperature. The solution of DDT and kerosene penetrated into the leaves within half an hour ; that containing aluminium stearate had penetrated at only a few small points by this time, and the solvent had left the surface by evaporation 20 hours after application. The first solution penetrated the branches completely in a few minutes, whereas some of the other could still be seen on the surface 20 hours later. Measurement of the DDT that was removed from the surface of the leaves and branches with benzene showed that 0·054 and 0·013 mg. per sq. cm. were retained on leaves sprayed with the solution with and without aluminium stearate and 1·181 and 0·384 mg. on branch surfaces.

The use of auxiliary solvents such as tetralin (tetrahydronaphthalene) and Velsicol AR-60 (mainly methyl naphthalenes) in 10 per cent. solutions in kerosene to make possible the addition of 8 per cent. DDT has a considerable but smaller effect in retarding the penetration of the kerosene, and leaves the crystals of DDT distributed in irregular strings on the lower surface of an orange leaf, with large areas apparently uncovered, instead of uniformly, as from a solution containing aluminium stearate.

In field experiments on *Citrus*, the addition of 1 per cent. aluminium stearate to a solution of 4 per cent. DDT in kerosene used as a 3 per cent. emulsion greatly increased the amount of DDT left on the surfaces of all parts of the tree, including the rough bark, the deposit being plainly visible, whereas most of the DDT in the same spray without aluminium stearate was carried into the tree in solution. DDT dissolved in light medium spray oil also penetrated the tree with the oil to a large extent. Analysis showed 3–4 times as much DDT on *Citrus* foliage when 1 per cent. aluminium stearate was added to the kerosene solution, and similar increases were caused by aluminium stearate when auxiliary solvents such as tetralin were used to increase the amount of DDT in the kerosene. Auxiliary solvents with boiling points higher than kerosene had a tendency to carry the DDT crystals into the tree to some extent, in spite of the retarded penetration, and the results were less striking.

STANLEY (W. W.). **Leaf Area and its Relation to Application of Insecticides.**—*J. econ. Ent.* **38** no. 6 pp. 703–705, 1 graph, 1 ref. Menasha, Wis., 1945.

A recommendation to treat a crop with a given amount of insecticide per acre against a leaf-eating insect is insufficient, since the factor of importance is the amount of leaf surface to be covered and not the ground area. Investigations on the leaf area of bunch bean and burley tobacco plants during their period of growth in the field in Tennessee were therefore undertaken. These plants were selected because of their different shapes and because both are commonly treated with insecticides.

The following is based on the author's summary. The leaf area of beans increased much faster than that of tobacco, the average daily rates of growth being 12·67 and 6·77 per cent. The bean plants averaged a maximum of 3·3 sq. ft. per plant and the tobacco 22·68 sq. ft., but the total leaf area per acre was slightly over 5 acres for both crops. Since the area of the leaves to be treated may be 5–10 times more than the ground acreage, instructions for the application of insecticides should indicate the stage of development of

the plant. Investigations on median lethal doses showed that for effective results an insecticide should be applied in the field in doses approaching those used in laboratories.

CREIGHTON (J. T.). *Platypus compositus* **attacking** *Citrus*.—*J. econ. Ent.* **38** no. 6 p. 706, 2 refs. Menasha, Wis., 1945.

Platypus compositus, Say, which is common and attacks numerous deciduous trees in the southern United States, has been taken on *Citrus* in Florida. It caused appreciable damage in a seedling grove in one place and severe sporadic damage to orange trees, attacking the branches as well as the trunks, in another. These infestations followed a prolonged rainy period.

PRICE (W. A.). **The Alleghany Mound Ant and its Control.**—*J. econ. Ent.* **38** no. 6 p. 706. Menasha, Wis., 1945.

Formica exsectoides, Forel, which has long been known on the sandy slopes of mountains in Pennsylvania, appeared on a farm near Louisville, Kentucky, in 1928. Attempts to eradicate it were unsuccessful, and it occurred on about 30 farms in the area in 1943. About 18 mounds per acre were found, and the numbers appeared to be increasing rather rapidly. Tests of insecticides showed that a stock solution (Red Arrow), containing 2 per cent. pyrethrins and 33 per cent. vegetable oil soap, diluted at the rate of 2 oz. per 10 U.S. gals. water, kills all ants that come into contact with it and exterminates the entire colony within a few seconds when poured into an open mound. The top of the mound is pulled down to form a crater with an inside diameter approximately that of the base of the hill, and 10 U.S. gals. of solution are necessary for a mound $2\frac{1}{2}$ ft. in diameter. The same treatment was effective against other species of ants.

KNOWLTON (G. F.). **Two Squash Root Aphids.**—*J. econ. Ent.* **38** no. 6 p. 707. Menasha, Wis., 1945.

On 18th July 1941, *Trifidaphis phaseoli*, Pass., and *Aphis middletoni*, Thos., were extremely injurious to young squash plants in a ten-acre field at Roosevelt, Utah. Both Aphids were present on the roots of all the squash plants examined, and they were attended by large numbers of the ant, *Lasius niger* var. *neoniger*, Emery. From 20 to 50 per cent. of the plants in different parts of the field were dead, and many small plants appeared to be stunted or in such poor condition that their survival was doubtful.

KNOWLTON (G. F.). **Elateridae eaten by Utah Birds.**—*J. econ. Ent.* **38** no. 6 p. 707, 2 refs. Menasha, Wis., 1945.

The stomach contents of over 2,000 birds taken in Utah in 1934–45, chiefly in late summer and autumn and mostly on range land, included 108 adults and 10 larvae of Elaterids, a smaller proportion than has been found by other workers in spring. One or more adults were found in one or more birds of each of the 29 species examined ; the actual numbers are shown in a table.

KNOWLTON (G. F.). *Labops* **Damage to Range Grasses.**—*J. econ. Ent.* **38** no. 6 pp. 707–708. Menasha, Wis., 1945.

Large numbers of the Mirid, *Labops tumidifrons*, Knight, were observed during 1945 on clumps of giant wild rye grass (*Elymus condensatus*), an important winter pasture plant for livestock, near Bear Lake, Utah, at an altitude of 6,010 ft. Its feeding punctures caused white spots on the leaf blades and they were so numerous that the discoloured grass could be recognised at a

distance of ¼ mile. The infestation was confined chiefly to one low ridge, at the edge of which *Elymus* gave way to a dense growth of several other grasses in which the bugs were causing varying amounts of damage to at least five additional species.

L. hesperius, Uhl., was collected in 1945 at elevations of 8,000 feet or more in Utah, where it was causing moderate injury to several grasses. *L. hirtus*, Knight, was abundant and fed on range grass at Amalga, Utah, on 2nd July 1937, and three examples were collected at Franklin, Idaho, on the same date.

Siegler (E. H.) & Gertler (S. I.). **Toxicity Tests of certain N-substituted 2, 4-Dinitroanilines on Codling Moth Larvae.**—*J. econ. Ent.* **38** no. 6 pp. 708–709. Menasha, Wis., 1945. ***N*-substituted *p*-Toluenesulfonamides to control Codling Moth Larvae.**—*T.c.* p. 715, 3 refs.

Siegler (E. H.) & Fleck (E. E.). **Alpha-trichloromethyl-substituted Benzenes to control Codling Moth Larvae.**—*T.c.* pp. 716–717.

Tables are given in these papers showing the results of tests on larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., by the apple-plug method [*cf. R.A.E.*, A **23** 174] with 47 organic compounds used at the rate of 4 lb. per 20 U.S. gals. ethyl alcohol (95 per cent.) and 80 U.S. gals. water. One of the 22 N-substituted 2,4-dinitroanilines, 2,4,4′-trinitrodiphenylamine, was slightly more effective than lead arsenate, but the other 46 compounds showed little or no toxicity. The ten benzene derivatives dealt with in the third paper were tested, in view of the occurrence of an α-trichlormethyl radical in DDT, to determine whether the presence of one or more examples of this radical has a marked influence on their toxicity. The toxicity of α,α′,α″-nonachlormesitylene, which had the highest number of chlorine atoms, was somewhat greater than that of the other benzene derivatives; differences in chemical constitution did not modify toxicity.

Richardson (C. H.). **Rate of Penetration of Nicotine into the Cockroach from Solutions of various Hydrogen Ion Concentration.**—*J. econ. Ent.* **38** no. 6 pp. 710–711, 3 refs. Menasha, Wis., 1945.

The results are given of experiments carried out in 1935 on the rate at which nicotine penetrates the body surface of *Periplaneta americana*, L., from solutions with different pH values. Adults were submerged for 16 minutes in nicotine solutions adjusted to the desired pH value with sulphuric acid at a temperature of 25–26°C. [77–78·8°F.], the head and prothorax being kept above the surface to prevent ingestion. After immersion, the cockroaches were washed to remove the surface nicotine, and the amount absorbed in the entire insect was determined.

The results showed that appreciable quantities of nicotine were absorbed from solutions in which the alkaloid was almost completely ionised and that absorbed nicotine had a definite toxic effect. Comparison with those of tests with nicotine vapour [*R.A.E.*, A **24** 691] indicated that *P. americana* absorbs nicotine more rapidly from the air than from aqueous solutions, which confirms the greater toxicity and greater speed of penetration of nicotine molecules than of ions in a large, resistant, terrestrial insect.

Flanders (S. E.). **Coincident Infestations of *Aonidiella citrina* and *Coccus hesperidum*, a Result of Ant Activity.**—*J. econ. Ent.* **38** no. 6 pp. 711–712, 3 refs. Menasha, Wis., 1945.

Although *Aonidiella citrina*, Coq., has ceased to be generally distributed as a pest of English ivy [*Hedera helix*] and *Citrus* in residential districts of California since the establishment of its parasite, *Comperiella bifasciata*, How., in 1931,

annual inspections made since 1939 of orange trees growing in the streets of Redlands, showed certain of them to be heavily infested with the scale, despite the presence of *Comperiella*. Workers of the Argentine ant [*Iridomyrmex humilis*, Mayr] were present on these trees collecting the honeydew of *Coccus hesperidum*, L. *A. citrina* was quite generally distributed over each tree, but was densest in the vicinity of the localised patches of *C. hesperidum*, where the ants were numerous. All parts of the tree infested by *A. citrina* appeared to be visited by one or more ants so frequently as largely to preclude oviposition by *Comperiella*.

An ant barrier, placed on one of two adjacent and equally infested orange trees in the summer of 1943, kept it free from ants in 1944 and 1945, and examination of heavily infested leaves in the spring of 1945 showed that *Comperiella* was working much more effectively on this tree than on the other. *Coccus hesperidum* had disappeared from the banded tree, presumably because the absence of ants had allowed the parasite, *Metaphycus stanleyi*, Comp., to destroy it or resulted in its drowning in its own honeydew. A large proportion of dead unparasitised examples of *A. citrina* on this tree indicated that many were destroyed by *Comperiella* merely through mutilation of the viscera by its ovipositor. In October 1945, no living examples of *A. citrina* were found on the banded tree, whereas it had increased considerably during the summer on the unbanded one. A few examples of *A. aurantii*, Mask., none of which was parasitised, were found on both trees.

Scott (L. B.) & Milam (J.). **Hessian Fly Infestation in Tennessee and Kentucky.** —*J. econ. Ent.* **38** no. 6 pp. 712–713. Menasha, Wis., 1945.

In mid-April 1945, wheat in Montgomery County, Tennessee, that showed leaf yellowing and formed comparatively few heads, was found to be heavily infested by *Mayetiola* (*Phytophaga*) *destructor*, Say. Infestation was found in every field examined, and in one field every plant examined was infested and many contained 15 or more larvae and puparia at the base of a single stem. Late-planted wheat was more severely damaged than early wheat ; barley was less affected. It seemed likely that the resultant loss of grain in the county would be about 33 per cent., and similar losses were recorded in Robertson County, Tennessee, and in four counties in Kentucky. *M. destructor* is not considered a major pest of wheat in north-central Tennessee, and the infestation was unusual in that severe damage was observed at least a month before the spring generation would have normally occurred. This was due to the emergence of adults of the overwintering generation about the middle of March, when conditions were favourable for adult migration and egg hatching, owing to unusually high temperatures and adequate rainfall. Emergence continued throughout April, and a spring generation emerged in May. In general, attack was restricted to green succulent tillers, indicating that the wheat had only recently become infested, and the fact that the infestation was confined largely to late-planted wheat also indicates that the damage was done in spring. Larvae of the second spring generation, which were moderately abundant towards the end of May, damaged small succulent tillers of late-planted wheat, but the injury was much less severe.

Walton (R. R.). **Chinch Bug Dust Barrier : preliminary Tests.**—*J. econ. Ent.* **38** no. 6 pp. 713–714, 1 ref. Menasha, Wis., 1945.

The results are given of experiments in Oklahoma in 1945 to compare the effectiveness against the chinch bug [*Blissus leucopterus*, Say] of dust barriers of 2 and 4 per cent. dinitro-ortho-cresol in pyrophyllite, ground sabadilla seed and lime (1 : 1) mixed with various proportions of pyrophyllite (Pyrax ABB) and a 5 per cent. DDT dust, prepared by mixing equal parts of Gesarol A-10 and pyrophyllite. In small-scale modified field tests made in June–September to

determine the effectiveness of barriers during a period of 96 hours after construction, 10 per cent. sabadilla was the only dust that prevented most of the bugs from crossing the barrier in 10–20 minutes. The only one tested under all conditions was 2 per cent. dinitro-cresol, which killed averages of 32·3–73·1 per cent. of the bugs that crossed. On the occasions on which they were tested, 4 per cent. dinitro-cresol was somewhat more effective than 2 per cent., 2 per cent. sabadilla less so, 5 per cent. sabadilla more so under wet or dry conditions but less so in wind, while 10 per cent. sabadilla was much more effective than any other dust with which it was compared and gave over 90 per cent. mortality in all but one test. DDT was inferior to 2 per cent. dinitro-cresol at the end of the test periods, and though the mortality had increased somewhat by the end of six days, it was still not very great. Gusty winds reduced the effectiveness of barriers by sweeping bugs over them and eroding dust lines, so that there was a general decrease in the effectiveness of the barriers as their age increased.

In field tests begun on 19th June, 2 and 4 per cent. dinitro-cresol dusts were compared with coal-tar creosote in barriers between the margins of an infested wheat field and a maize field. Conditions were unfavourable for the use of dusts; rain destroyed the barriers three times, and they were constructed in all five times, using a total of about 3¼ lb. dust per 10 yards; the creosote was applied twice, using about 4 U.S. pints per 50 yards. The dinitro-cresol barriers killed large numbers while they remained dry, but each time they were destroyed by rain, the bugs invaded the maize, and the barriers had been moved back to the eighth or ninth row in the field by 29th June, when a large proportion of the insects had transformed to adults. No appreciable numbers crossed the creosote barrier. A flock of young and mature turkeys that ranged over the field during the test suffered no harmful effects, and two ten-week-old turkeys in a cage with a band of 2 per cent. dinitro-cresol applied at about 2 lb. per 11 yards were not affected, though they pecked the dust at times.

Simmons (P.) & Fisher (C. K.). **Ethyl Formate and Isopropyl Formate as Fumigants for Packages of Dried Fruits.**—*J. econ. Ent.* **38** no. 6 pp. 715–716. Menasha, Wis., 1945.

Ethyl formate has been successfully used since 1927 in the United States for the fumigation of individual packages of dried fruit; a small quantity is pumped into the package just before the dried fruit is put in, after which the package is immediately sealed, and the resulting vapour kills any insects or eggs that may have escaped removal during cleaning and washing of the fruit [*cf. R.A.E.*, A **31** 391]. The usual dosage for a 25 lb. box of raisins ranges from about 4 ml. in hot weather to 7 ml. in cold weather. Dosages for different kinds of packages should be determined by experimental exposures of insects sealed in with the contents. The treatment is said to be more effective when used in solid fibreboard cases than in fluted ones, and is not effective in wooden boxes unless they contain a paper-bag liner; as ethyl formate removes protecting films from metal, iron and steel parts may become somewhat corroded. A similar fumigant, isopropyl formate, is about as effective and costs practically the same. Only very pure samples of the compounds should be used in the fumigation of dried fruits. As both are poisons adequate means should be provided for carrying the fumes away from workers, and as there is danger of fire at certain concentrations, it is recommended that a ventilating hood should be installed over the point where the liquid is released into the packages.

Mason (A. C.) & Chisholm (R. D.). **Ethylene Dibromide as a Fumigant for the Japanese Beetle.**—*J. econ. Ent.* **38** no. 6 pp. 717–718, 1 ref. Menasha, Wis., 1945.

Preliminary investigations begun in the spring of 1945 showed that ethylene dibromide was an effective fumigant against larvae, pupae and eggs of *Popillia japonica*, Newm., in the soil and against adults under atmospheric conditions.

Since the compound has a melting point of 50°F. and is therefore solid under some conditions of use, it was diluted with ethylene dichloride to form mixtures having lower melting points for use against the immature stages. Stock mixtures of ethylene dibromide, ethylene dichloride and a polyoxyalkylene derivative of sorbitan monolaurate (Tween 20), a surface-active agent (16 : 81·5 : 2·5 and 62 : 36 : 2 parts by weight) were emulsified with 1–2 volumes of water and then diluted with water to the required strengths ; they form clear solutions at concentrations of about 10 ml. or less per U.S. gal. The quantities of ethylene dichloride used are considered too small to have much toxicity.

Third-instar larvae in balls of soil round the roots of plants were killed by dipping the balls for ten seconds in solutions containing only 0·63 ml. of the second mixture per U.S. gal. water ; the larvae were left in the treated balls for 24 hours at temperatures of 40–70°F., and almost all of them died 1–10 days after removal. Larvae in one-inch cubes of soil were killed by similar treatment with 2·5 ml. of the first mixture per U.S. gal. at 50–70°F. Larvae removed from soil were killed by immersion for ten seconds in an emulsion containing 30 ml. of the first mixture or 20 ml. of the second. Larvae in turf in the upper four inches of a loam soil were killed when 10 ml. of the first mixture in 1 U.S. gal. water was applied to each square yard of surface at temperatures of 60–80°F. ; in nurseries, a dosage of 20 ml. in 1 U.S. gal. water was required to kill larvae ten inches deep in clay and loam soils at 50°F. In all cases, most of the larvae were dead when removed seven days after treatment, but a few survived for additional periods of up to ten days.

At 70°F., pupae in plant balls were killed by immersing the balls for ten seconds in a solution of 5 ml. of the first mixture per U.S. gal. In plots of sandy-loam soil a yard square, 8 ml. of the second mixture applied to the surface in 1 U.S. gal. water was required to kill all the pupae. A dosage of 20 ml. of the first mixture in 1 U.S. gal. water killed about 98 per cent. The mortality of all pupae was delayed.

Eggs in soil masses were generally killed by immersion for ten seconds in solutions of 5 or 10 ml. of the first mixture per U.S. gal. water at 70°F. In some samples, none of the eggs hatched, but a few first-instar larvae were recovered from others.

In tests with adults, ethylene dibromide was heated to about 125°F. in a fumigation chamber, and the vapours were withdrawn from the heating unit, mixed with air and dispersed throughout the chamber by means of a fan. The beetles were killed by exposure for two hours to a dosage of 0·5 lb. per 1,000 cu. ft. at temperatures of 50–70°F.

Preliminary tests indicated that plants will tolerate only small doses of ethylene dibromide, but several plants were not injured by the dosages found to be lethal to the immature stages of *P. japonica*, and fumigation at the rate required to kill the adults did not injure several kinds of fruits and vegetables.

STEINHAUS (E. A.). **Bacterial Infections of Potato Tuber Moth Larvae in an Insectary.**—*J. econ. Ent.* **38** no. 6 pp. 718–719, 2 refs. Menasha, Wis., 1945.

Ever since larvae of *Gnorimoschema operculella*, Zell., were first used for laboratory rearing of the parasite, *Macrocentrus ancylivorus*, Rohw., in California [*cf. R.A.E.*, A **32** 367], small numbers have been found dead in the rearing trays or on the cocooning cards. Gross examination of dead and dying larvae showed them to have symptoms characteristic of bacterial disease, and microscopic examination revealed extremely large numbers of small rod-shaped bacteria ; examination for microsporidia and for polyhedra gave negative results. About 25 per cent. of the dead larvae were bright red, and the rest dark brown or black, and cultures on agar showed that the former contained a deep red strain of *Serratia marcescens*, whereas the latter contained one or

other of two gram-negative, non-sporeforming small rods. One of these was repeatedly isolated from larvae dying between 21st and 23rd July and the other from those dying between 26th and 31st July 1945, the only difference in the production procedure for the two periods being the use of different supplies of potatoes as food for the larvae. One of these bacteria appeared to be a strain of *Aerobacter*, probably *A. cloacae*, and the other seemed to be a coliform of the slow lactose-fermenting group. Some infected larvae pupated, after which they assumed the black or red colour of diseased individuals.

Feeding and inoculation experiments showed that all three organisms were pathogenic to *G. operculella*, both when they were inoculated into the body cavity and when they were fed to the larvae, but particularly when they were inoculated. Cultures made of washings of the various kinds of equipment used in rearing the larvae showed the three bacteria to be uniformly present, and it is likely that the ultimate source was the potatoes used for rearing, since the natural habitat of all three species includes the soil in which potatoes are grown and they were isolated directly from washings of the sacked potatoes before they were used.

CALLAN (E. McC.). **Distribution of the Sorghum Midge.**—*J. econ. Ent.* **38** no. 6 pp. 719–720, 1 map, 6 refs. Menasha, Wis., 1945.

The world distribution of the sorghum midge, *Contarinia sorghicola*, Coq., is reviewed from the literature [*cf. R.A.E.*, A **28** 633; **30** 168, 365, 499; **32** 24, 138] and shown on a map. The most recent records are from Antigua and St. Kitts in 1943 and Barbados in 1944.

FRAZIER (N. W.). **Sabadilla for the Control of the Green Stinkbug.**—*J. econ. Ent.* **38** no. 6 p. 720. Menasha, Wis., 1945.

A dust of ground sabadilla seed treated with alkali and diluted to contain 0·1 per cent. sabadilla alkaloids [*cf. R.A.E.*, A **34** 301] was tested in a peach orchard in California in which the developing fruit was being damaged to a considerable extent by *Acrosternum hilare*, Say. An application to the lower branches of two trees on 12th July 1945, when nymphs of all instars were common but adults scarce, caused some of the insects to fall to the ground within ten minutes and others during the following 52 hours; the fact that bugs higher up in the tree were exposed to decreasing amounts of dust may account for the extended period over which the insects dropped. Some of the fallen bugs were not dead, but none recovered when kept in a shaded tree crotch for several days. On 14th July, the whole orchard (in which the trees were 30 ft. or more high) was treated with 50 or 75 lb. dust per acre, and on the next day 19 bugs were found on cloths put under three of the trees that received the lower dosage. These trees were dusted thoroughly on 16th July, but no further bugs fell from them, indicating that the first treatment had been effective. It is concluded that sabadilla offers excellent promise of controlling *A. hilare*.

BREAKEY (E. P.). *Phyllocoptes gracilis* **and the Dry Berry Disease of the Loganberry.**—*J. econ. Ent.* **38** no. 6 p. 722, 1 ref. Menasha, Wis., 1945.

Hard and misshapen fruits have of recent years formed up to 50–70 per cent. of the loganberry crop in some plantings in western Washington, and the cause of the condition was not known. In June 1945, however, young fruits showing this injury were found to be heavily infested by an Eriophyid identified as *Phyllocoptes gracilis*, Nal., by Keifer, who agreed that it was probably the cause. The fruits from the earlier blossoms are the most severely injured, and the mite appears to be a more serious pest of loganberries than of red raspberries [*cf. R.A.E.*, A **34** 75], on which the injury becomes evident late in the season.

Carlson (F. W.) & Yothers (M. A.). **The Persistence of Toxicity to Codling Moth Larvae of 4,6-Dinitro-o-cresol applied as a Tree-trunk Spray.**—*J. econ. Ent.* **38** no. 6 p. 723, 3 refs. Menasha, Wis., 1945.

Rough-barked apple trees in Washington that had been sprayed on 27th March 1943 at the rate of 3–5 U.S. gals. per tree with an emulsion of oil containing dinitro-o-cresol and a penetrant against larvae of the codling moth [*Cydia pomonella*, L.] hibernating in the bark [*R.A.E.*, A **32** 273] were re-examined on 22nd May 1944. In addition to some living larvae and a number of dried ones that might have died at any time since the spray was applied, there were considerable numbers of dead larvae that were still flaccid. These were evidently overwintering individuals that had been killed within the previous few weeks by material still remaining on the trees. Preliminary chemical analysis and the presence on the bark of characteristic yellowish deposits indicated that dinitro-cresol was still present, but the distribution was more uneven than it had been immediately after application. It was evident that sprays applied in the summer and rains had washed some of the material from the more exposed places into sheltered ones. No injury to the trees was observed as a result of this persistence of toxicity in the dinitro-cresol, even in the crotches or at the base of the trees in the soil, where the concentration was greatest.

Yothers (M. A.) & Carlson (F. W.). **Three Years of Orchard Tests of 4,6-Dinitro-o-cresol against overwintering Codling Moth Larvae.**—*J. econ. Ent.* **38** no. 6 pp. 723–724, 2 refs. Menasha, Wis., 1945.

Studies of scraping and banding apple trees as a supplementary control measure against the codling moth [*Cydia pomonella*, L.] in the irrigated orchards of the Pacific northwest, made from 1935 to 1942, showed that 95–100 per cent. of the overwintering larvae make their cocoons on the trees and that 95–98 per cent. of these do so on the larger branches and tree trunks, chiefly above ground level but to some extent below. In experiments carried out in 1941–44 with sprays to destroy them [*cf. R.A.E.*, A **31** 112 ; **32** 273], one containing 4 lb. dinitro-o-cresol in 10 U.S. gals. stove oil per 100 U.S. gals. water, with 4 lb. sodium lauryl sulphate or 4 U.S. pints Tergitol 7 [a sodium sulphate of a higher, synthetic secondary alcohol] as emulsifier and 3 U.S. gals penetrant [**32** 273], applied in March, killed 84–99 per cent. of those on the sprayed portions of the trees within 2–3 weeks. A spray containing 3 lb. dinitro-cresol and 15 U.S. gals. oil per 100 U.S. gals. with no penetrant gave 56–83 per cent. kill, and was about as effective when used by growers on apple and pear in 1944.

Dean (R. W.). **DDT Sprays and European Red Mite Populations in eastern New York.**—*J. econ. Ent.* **38** no. 6 pp. 724–725, 1 graph. Menasha, Wis., 1945.

Since two years' use of DDT in as many as six cover sprays on apple in eastern New York did not result in serious infestation by the European red mite [*Paratetranychus pilosus*, C. & F.] such as has been recorded by other workers, the effect of the compound on an established population of the mite was studied in the summer of 1945. Cover sprays containing 0·8 lb. actual DDT per 100 U.S. gals. were applied to apple trees on 6th, 18th and 28th June, 9th July and 7th and 16th August, and the mites were counted on samples of 25 leaves from each of four trees taken at intervals of 10–14 days between 1st June and 15th October. The populations are plotted on a graph, which shows little difference between those from sprayed and from unsprayed trees. In both cases, populations rose to a peak towards the end of June and were very low by the beginning of August. The numbers were higher on unsprayed trees in the second half of June. There was a slight rise in population on sprayed trees in

September and early October, though the maximum was less than 40 per cent. of the average at the beginning of June, but not on unsprayed trees. This difference was probably due to the superior condition of the foliage on sprayed trees.

Predators found on the leaf samples comprised two mites of the genus *Seius* on sprayed ones and 36 individuals, including thrips, *Stethorus* larvae and *Seius*, on unsprayed ones. In neither case were they numerous until late in the season, when *Seius* became fairly common, and it was evident that the decline in numbers of *P. pilosus* was not due to predators or to any other controlling factor that was affected by the DDT sprays.

An outbreak of mites developed between mid-August and mid-September in another apple orchard sprayed with DDT, but the predominant species was found to be *Tetranychus telarius*, L., and only small numbers of *P. pilosus* were present.

FREEMAN (J. A.). **Studies in the Distribution of Insects by aerial Currents. The Insect Population of the Air from Ground Level to 300 Feet.**—*J. Anim. Ecol.* **14** no. 2 pp. 128–154, 3 figs., 1½ pp. refs. London, 1945.

The following is almost entirely the author's summary. The insect aerial population above an area of agricultural land in Lincolnshire was sampled in 1934 and 1935 at heights of 10, 177 and 277 ft., over a front of 4,400 ft., by nets flown from the masts of a beam wireless station. The population consisted mainly of small weak-flying insects of high buoyancy borne involuntarily by the wind. The 21,276 individuals collected included a number of insects of agricultural importance and 3,334 of *Brevicoryne brassicae*, L., which was the commonest species. Diptera were most numerous near the ground, Hemiptera were dominant above 100 ft., and Aphids were the most numerous family at all heights. Insects that were confined to ground level occurred less frequently than those taken at all heights. The species collected may be classified into " aerial " and " terrestrial " forms according to their vertical distribution, and lists are given of typical species and families in these groups. It was found that the local vegetation determined the general character of the aerial fauna, which showed significant changes from month to month. These changes were generally uniform over the whole front, whether broad or narrow, indicating considerable insect activity over an extensive area, although unevenness occurred, especially at ground level, owing to the close proximity of breeding places to particular nets. The greatest number and variety of insects occurred in May, June and September, times of activity in mating and dispersal. Maximum numbers of most groups occurred at relative humidities below 59 per cent., at wind velocities of 12 m.p.h. and below and at temperatures in excess of 64°F., temperature being the factor of greatest importance. The biological and economic aspects of wind dispersal are discussed, particularly in relation to the results of this work in emphasising the importance of moderate winds and wind drift rather than that of hurricanes and storms.

KEMP (H. H.) & GRASBY (C. G.). **The Grape Vine Mite** (*Tenuipalpus phoenicus* **Geij.**).—*J. Dep. Agric. S. Aust.* **45** no. 3 pp. 181–182, 2 figs. Adelaide, 1941.

Tenuipalpus californicus, Banks (*phoenicis*, Geijskes)* was found infesting the lower surface of the leaves of grape-vines of the Doradillo variety at Waikerie, South Australia, in February 1939; it had not previously been recorded from South Australia, although it is known to occur on vines in New South Wales [*cf. R.A.E.*, A **30** 156; **32** 64, etc.] and Victoria. It attacked the leaves close to the veins, causing the tissues round the veins to become

* Synonymy from H. Womersley, *Trans. roy. Soc. S. Aust.* **65** p. 42. 1941.

bronzed in a characteristic manner. The stems of the fruit clusters and of the berries were also heavily infested and became darkened and roughened. The bark of the lower internodes was scarred in a similar mannner, owing apparently to infestation earlier in the season. Scarring of the berries [*cf.* **22** 622] was not observed in South Australia. In many cases, berries at the upper end of infested bunches had fallen, evidently as a result of feeding by the mites on the pedicels. A survey showed that the mite was well established in all the vine-growing centres on the Murray River [**30** 472]. It caused injury on several varieties of vine, but Doradillo was the one most severely attacked, probably because the lower surface of the leaves is densely covered with hairs ; many vines of this variety were almost defoliated by the end of February, although the weather was unusually mild. The berries that developed were normal in size, and their sugar content was fairly good.

Experiments on control were carried out in the 1940–41 season, when infestation was light, on vines that had been heavily infested during the previous season. All the sprays tested were equally effective in reducing damage to the stems and foliage, but there were differences in the reduction of fruit damage. Sprays of lime-sulphur (1 : 10), red oil (1 : 15) or tar distillate (1 : 30) applied in winter against the adults overwintering under loose bark and in crevices in the main branches and stems of the vines were about equally effective and better than no treatment, but control was probably hindered by the thickness and roughness of the bark. Better results were given when these treatments were followed by lime-sulphur (1 : 70) in spring, when the shoots were 9–12 ins. long and the mites had left their winter quarters, and the double treatment with lime-sulphur prevented all damage to the bunches [*cf.* **22** 622]. Lime-sulphur in spring alone was only slightly inferior and is recommended.

KEY (K. H. L.). **The general ecological Characteristics of the Outbreak Areas and Outbreak Years of the Australian Plague Locust** (*Chortoicetes terminifera* **Walk.**).—*Bull. Coun. sci. industr. Res. Aust.* no. 186, 127 pp., 8 pls., 13 figs. 3 fldg. maps, 53 refs., multigraph. Melbourne, 1945.

A detailed account is given of investigations on the general characters of the areas and years in which outbreaks of *Chortoicetes terminifera*, Wlk., occur in Australia, with special reference to those that are of importance in relation to swarm formation. It is based on observations in New South Wales and southern and central Queensland in 1936–42 [*R.A.E.*, A **26** 583 ; **27** 545 ; **31** 422 ; etc.], and work by other investigators in South Australia [**24** 635 ; **28** 593 ; etc.].

The following is based almost entirely on the author's summary and conclusions. Climatic characteristics of the outbreak areas were defined by comparing the distribution of outbreak areas delimited in 1938 from the evidence of swarm movements [**26** 583] with the distribution of certain measures of climate that are known to be of importance in the ecology of *Chortoicetes*. These comprise the number of months in a normal year in which moisture, measured as the Meyer ratio [**29** 141], is too great for multiplication, the number in excess of three in which it is deficient, and a climatic index [**30** 101, 421]. The outbreak areas delimited in 1938 lie within or very close to a climatic zone in which the normal season has no month too moist, no successive three months too dry, and a climatic index of 73 or more. Differences in the values of these climatic measures in the individual years comprising a complete sun-spot cycle are described, and it is concluded that the climate of the zone enables an average of at least one generation of *Chortoicetes* to develop during the year without high mortality. Most of the outbreak areas discovered since 1938 have substantially the same climatic characteristics, and in those that deviate at all widely there is evidence that swarm-production is largely dependent on flooding. The climate of the outbreak areas is also represented by means of a

climatograph based on the average climate in a number of representative areas, which shows that the Meyer ratio fluctuates between 3·5 and 8 during the period of favourable temperatures.

Within the favourable climatic zone, a close correlation was found between the distribution of tree-less self-mulching soils (chernozems, serozems, rendzinas and certain alluvial soils) and that of the outbreak areas, including those that are in dry areas and are dependent on flooding. On the other hand, outbreak areas were not associated with self-mulching soils under timber or with regions of self-mulching soil situated on the humid side of the favourable climatic zone. These soils usually form a mosaic with compact soils, especially in the more active outbreak areas, of which the occurrence of both types in close association is regarded as an essential characteristic. The environment represented by the mosaic of the two soil types is described in some detail. The clay content of the compact soils is usually less than 27 per cent., though it may exceed 35 if the silt content is higher than about 20 per cent., whereas that of the self-mulching soils is usually above 27 per cent. and sometimes exceeds 50. Arising chiefly from this difference are important secondary differences in compactness, penetrability, water-holding capacity and available water. Compact soils are well-drained, but there is little drainage of self-mulching soils on outbreak areas in flat districts, which are more numerous and important than those in hilly districts, and these are frequently subject to flooding. Considerable wind erosion has occurred on the compact soils in flat districts and increased the amount of bare ground present. The compact soils usually support tall or shrub woodland or, when cleared, a predominantly grass pasture, which under normal stocking is seldom tall or dense ; it does not contain markedly tussocky species and produces rapid, quick-maturing growth after light rain. Self-mulching soils that are tree-less or have been cleared bear a pasture that is composed of grasses in which tussocky species predominate, especially in depressions ; they require heavy rains for initiation of growth and remain greener for longer than those on compact soils. In the course of the development of the country, the natural vegetation has been modified by clearing, stocking, erosion and occasionally by the production of crops and sown pasture.

These topographical features favour swarm-formation by promoting both multiplication and concentration of the population of *Chortoicetes*. Bare areas of compact soil are selected for oviposition by both swarming and non-swarming populations and are evidently especially favourable for egg development or the survival of young hoppers or both. Older hoppers and adults are most abundant in the greener parts of the pasture on self-mulching soil, which provides both food and shelter. The two types of habitat are designated oviposition and food-shelter habitats, respectively. The areas occupied by them vary widely according to the season, and the portions that change least are termed the oviposition and food-shelter nuclei. Where an oviposition nucleus and a food-shelter nucleus are adjacent, and thus provide suitable conditions for both the egg and later active stages within the normal dispersal range of the non-swarming populations, high populations occur and these situations therefore constitute the outbreak centres.

The use of the term " concentration " is discussed and confined to the " real concentration " of J. S. Kennedy [**28** 30]. Concentration occurs when the food-shelter habitat contracts towards its nuclei during a dry period and probably when the oviposition habitat contracts towards its nuclei in a good season, and since concentration of one type or the other is constantly taking place, the decisive factor in swarm-formation is evidently the size of the population exposed to concentration. A part of the food-shelter habitat much larger than the nucleus (extension area), in which multiplication can take place in good seasons, is probably an important adjunct to the outbreak centre. Typical situations in which outbreak centres occur are described and include self-mulching depressions with compact margins and, in self-mulching country, the

margins of large patches of bare soil and roads with their associated table-drains.

The association of the outbreak centres in an outbreak area is important in enabling a primary swarm to find favourable conditions when it leaves its parent outbreak centre, and in promoting fusion of swarms. The occurrence of several outbreak areas along the line of migration assists the development of the outbreak. It is suggested that swarm formation is primarily a biological advantage, in that it makes distant favourable habitats available to the insects.

The limits of the recorded outbreak areas are redefined in the light of all available evidence and several new ones, as well as suspected ones, are recorded. In all 20 are now known in New South Wales, Queensland and Victoria, of which four, all in New South Wales, are of major importance, 11 of intermediate importance and five of minor importance. Several of the 14 suspected areas are in the Northern Territory and the north of Western Australia. The importance of the outbreak areas is classified according to the frequency with which they produce swarms and the size and density of the swarms produced. The distribution of the established and suspected outbreak areas is shown on a map, their physical characters are described, and the frequency of activity and direction of emigration of *Chortoicetes* discussed for each. Two regions in Queensland where existing outbreaks are likely to be extended and new outbreak areas created after clearing are also indicated.

An unsuccessful attempt was made to correlate outbreak peaks in New South Wales with sunspot numbers and various measures of weather. It is shown that the commencement of outbreaks in the Bogan-Macquarie outbreak area (New South Wales) is correlated with a rainfall of 8 in. or more during October–February of the season of swarm-formation, but no such correlation could be demonstrated for the Darling Downs outbreak area. Improved correlations between weather and swarm-formation in individual outbreak areas could probably be obtained by using more appropriate indices of weather, but it is unlikely that any close enough to be of use in forecasting outbreaks could be developed without periodical determinations of mean population density in the outbreak areas. On theoretical grounds, the outbreak region is divided into five outbreak provinces differing in the nature of the season probably conducive to swarm-formation.

It is pointed out that the knowledge gained regarding the characteristic features of the outbreak centres of *Chortoicetes* opens up a theoretical possibility of rendering these centres ecologically unsuitable for producing swarms.

JANNONE (G.). **Circolare sugli insetti e malattie più gravi delle patate esistenti in Eritrea o di cui si deve temere l'introduzione e relativi mezzi di lotta.** [Circular on the most important Insects and Diseases that attack Potato in Eritrea or may be introduced, and Methods of controlling them.]—8 pp., 4 figs. Asmara, Dip. Agric. Eritrea, 1943. **Per combattere un temibile parassita della patata** (*Phthorimaea operculella* **Z., Lepidoptera, Gelechidae) scoperto in Eritrea nel marzo 1943.** [The Control of an alarming Pest of Potato (*Gnorimoschema operculella*, Zell., Lepidoptera, Gelechiidae) discovered in Eritrea in March 1943.]—*E.D.N.* no. 564 repr. 7 pp. Asmara, 1943. **La lotta contro la tignola delle patate in pieno campo nella colonia Eritrea.**—[The Control of *G. operculella* on Potato in the Field in Eritrea.]—*E.D.N.* no. 618 repr. 8 pp., 1 ref. Asmara, 1943.

The two insect pests of potato discussed in the first of these papers are *Leptinotarsa decemlineata*, Say, which does not occur in Eritrea, and *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., which was first observed there in 1943 [*cf. R.A.E.*, A **34** 154]. On the Eritrean plateau (6,000–7,500 ft. above sea-level), this Tineid has several generations in the year, each lasting just over a month. The damage caused to the tubers is described. The measures of

control suggested are discussed at greater length in the second paper, in which it is stated that potato is the preferred food-plant, though other solanaceous plants are also attacked. Suggested control measures include one or more applications of a spray of 0·5 per cent. lead arsenate or calcium arsenate to the plants, though this is not very effective, since the larvae live chiefly within the tissues, fumigating the harvested tubers with 1 fl. oz. carbon bisulphide or 2 fl. oz. carbon tetrachloride per cu. ft. for 40–48 hours, and storing them after treatment in insect-proof buildings or under a layer of about two inches of dry sand or five inches of dry hay well pressed down. The moths can be caught by means of lights over basins of water with a film of oil on it, arranged 8–12 ins. above ground level at the rate of 1 per 48–60 sq. yards in the field or in the warehouse. Immediately after harvest, the haulms should be burnt or buried at a depth of 12–16 ins. in the field in which the plants were grown. Infested tubers should be buried at the same depth, rotted down under a layer of manure or kept in closed vessels until used as cattle food.

In the third paper, the author states that two species of Hymenopterous parasites were found in some parts of the colony [*cf.* **33** 379], reared in the laboratory and liberated in localities in which they did not occur. He also gives more detailed information on cultural control measures. They include planting uninfested seed potatoes at a depth of 5–6 ins. in straight rows at least 16–20 ins. apart, keeping the new tubers covered to a depth of 4–6 ins. and pressing down the soil lightly to eliminate openings. The furrows between rows of potatoes grown under irrigation in the hot dry season should not be more than about 6 ins. deep, so that the irrigation water keeps the soil of the ridges damp enough to prevent the formation of cracks that permit the entry of larvae and ovipositing adults. Irrigated crops should preferably be grown on light soils, which do not crack when dry ; irrigation should be more frequent on heavier soils, but care should be taken that the soil is not washed away. Tubers should be dug before the aerial parts of the plant die off, when the larvae migrate to the tubers, and none should be left in the soil.

ALIBERT (H.). **Note sur un nouvel insecte parasite des noix de** *Raphia* : *Leurostethus raphiae*, **Mshl.**—*Notes afr.* no. 28 pp. 15–16, 2 figs. Dakar, 1945.

The hard endosperm of seeds of *Raphia hookeri* has recently been used for the manufacture of buttons, and seeds exported from the Ivory Coast for this purpose were found in Morocco to be infested by *Leurostethus raphiae*, Mshl. [*R.A.E.*, A **34** 14], the adult of which is described. This weevil attacks the ventral surface of the seed in the region of the micropyle where it constructs galleries 1½ cm. in length and averaging ½ cm. in width and frequently causes necrosis, which ultimately destroys all the interior of the seed. Oviposition and larval development take place in the gallery, and the larvae feed on the plant embryo, but not to any extent on the endosperm ; if necrosis develops, they may occur anywhere in the seed. The larval stage lasts at least two months. The weevil apparently develops in the stored seeds but has not been observed in other stored products. The damage is not considered to be of great importance.

PAPERS NOTICED BY TITLE ONLY.

BIRCH (L. C.). **The biotic Potential of the small Strain of** *Calandra oryzae* **and** *Rhizopertha dominica*.—*J. Anim. Ecol.* **14** no. 2 pp. 125–127, 2 figs., 6 refs. London, 1945. [*Cf. R.A.E.*, A **34** 222.]

GOODHUE (L. D.), BALLINGER (W. R.) & FALES (J. H.). **Improved Dispenser for testing new Liquefied-gas Aerosols.**—*J. econ. Ent.* **38** no. 6 pp. 709–710, 1 fig., 4 refs. Menasha, Wis., 1945. [*Cf. R.A.E.*, B **32** 99.]

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